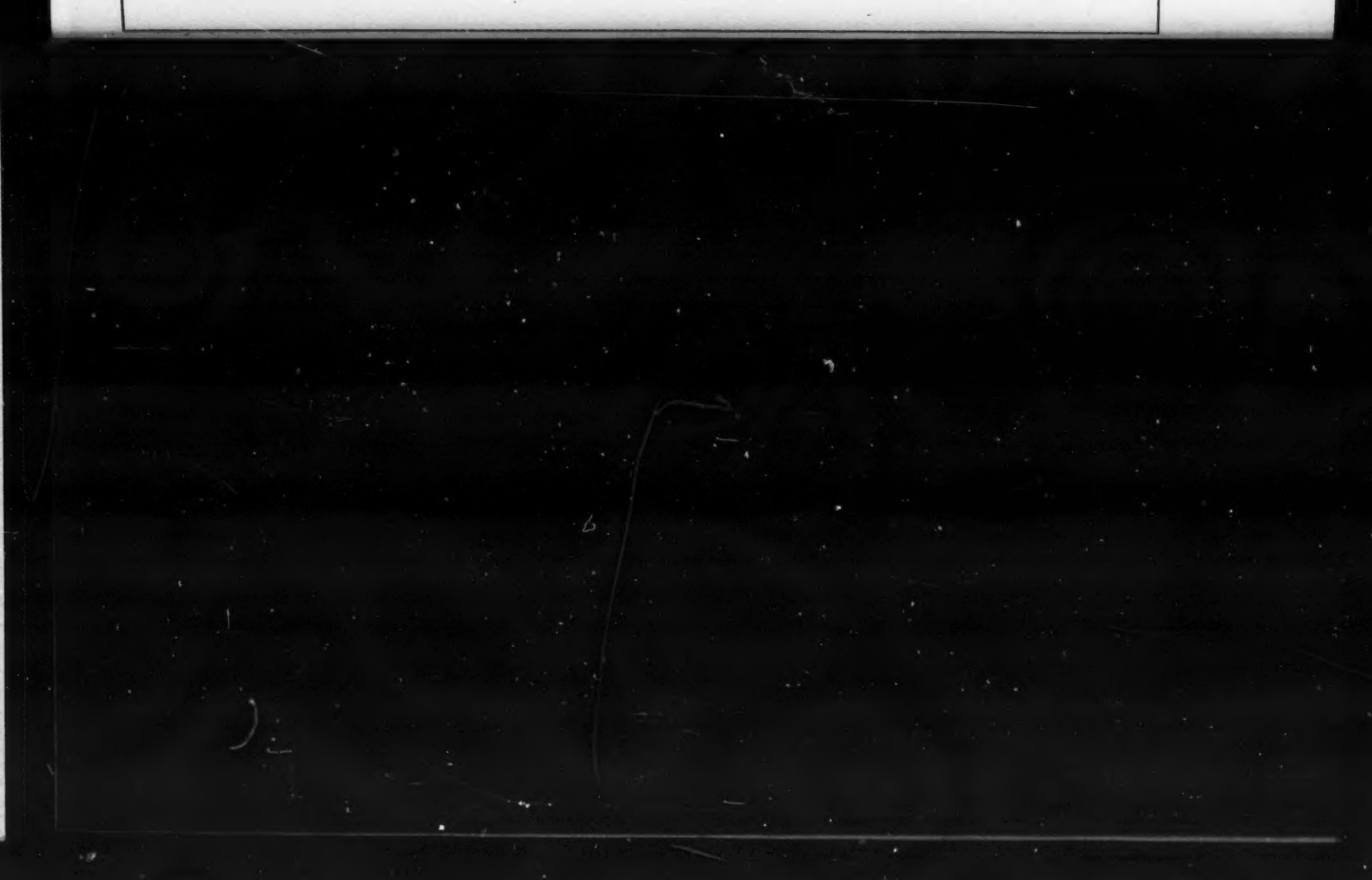

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IN THIS ISSUE

THE concept of public health has broadened and today the control of the chronic diseases is considered of major importance. The article "A Study of Illness Among Families in the Eastern Health District of Baltimore" by Miss Jean Downes of the Fund's staff and Selwyn D. Collins, Principal Statistician of the United States Public Health Service, is a preliminary report of a year's study of illness in a sample population. In this study, which is to continue over a period of years, special emphasis is placed upon the chronic diseases. Information is being secured concerning their frequency of occurrence, their duration in terms of total illness, of disability, bed, and hospital care.

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Despite the urgent importance of current unemployment, students of population have generally considered this problem as being outside their legitimate sphere for study. On the other hand, students of unemployment often fail to describe the problem with respect to age and sex characteristics and have heretofore made little attempt to assess the relative importance of reductions in numbers of jobs and sheer increments to the labor market arising from past natural increases in the population. In this issue Dr. Rupert B. Vance and Mrs. Nadia Danilevski present a paper, "Population and the Pattern of Unemployment, 1930-1937." By comparing data from the Unemployment Census in 1930 with the United States Census of Partial Employment, Unemployment, and Occupations, 1937, the authors studied the trends in unemployment by sex, age, and functional class. They used an ingenious method for estimating how much of the increase in unemployment from 1930 to 1937 arose from stoppage of previous employment and how much from increase in the population. This able analysis contributes much toward a better understanding of a complex problem.

EXT

Preventive measures in tuberculosis are based upon what is known of the etiology and the epidemiology of the disease. In the article, "Salient Points of Attack Against Tuberculosis," Miss Jean Downes of the Fund's staff reviews and discusses the recent advances in knowledge of the epidemiology of tuberculosis which point the way to a more direct and more specific program for the control of the disease.

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One of the most significant contributions to our knowledge of the epidemiology of tuberculosis was made by the late Dr. Wade H. Frost in the article, "The Age Selection of Mortality from Tuberculosis in Successive Decades." Dr. Frost concluded that change in human resistance is probably the predominant factor in the up-and-down movement of mortality along the age scale from infancy to old age. This study of Dr. Frost's is important because it increases our understanding of the age-selection of tuberculosis mortality.

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Familial incidence of any disease is one important aspect of the epidemiology of a disease. Evidence that the children in some families constitute a group susceptible to dental caries and that those in other families are relatively immune, has significant implications for further studies of the problem of dental caries and for a preventive program. The results of an analysis of the caries experience of brothers and sisters are presented by Dr. Henry E. Klein and Dr. Carroll E. Palmer in a paper on Familial Resemblance in the Caries Experience of Siblings. The authors conclude "that the existence of familial resemblances in caries experience of children is definitely established."

A STUDY OF ILLNESS AMONG FAMILIES IN THE EASTERN HEALTH DISTRICT OF BALTIMORE[1]

JEAN DOWNES AND SELWYN D. COLLINS

STUDIES of illness have in the past been conducted along two general lines: (1) the single visit survey, securing records of illness for a sample population on the day of the visit or for a limited period of time previous to the visit; and (2) the continued observation of illness in a sample population over a period of time by means of visits to the family at stated intervals. Each of these methods yields valuable results, though each may have limitations in the accuracy of the records of illness. Experience has shown that due to limitations of memory of the informant, minor respiratory and digestive conditions and other minor illnesses causing little or no disability are largely missed except for a limited period previous to the visit. In an effort to ascertain the maximum rate of illness in a sample population through relatively frequent observation, and to investigate particularly the chronic diseases, a special study is now being conducted among a sample of the white families in the Eastern Health District of Baltimore by the United States Public Health Service and the Milbank Memorial Fund in cooperation with the Johns Hopkins School of Hygiene and the Baltimore City Health Department. This paper presents a preliminary report of

[1] From the Division of Public Health Methods of the National Institute of Health and the Milbank Memorial Fund.

Acknowledgments are made:

To the Johns Hopkins School of Hygiene, especially to the Departments of Epidemiology, Biostatistics, and Public Health Administration, for generous assistance and cooperation which have greatly facilitated the carrying on of the study of illness in the Eastern Health District of Baltimore.

To the Baltimore City Health Department for generous assistance and cooperation, especially in the matter of relationships with the medical profession.

A special acknowledgment is made to the late Dr. Wade H. Frost, who repeatedly requested the initiation of such a study and who gave helpful suggestions in the preliminary plans for it.

certain data of illness observed in the first year's study during the period ending June 22, 1939.

When the special study was initiated, the Eastern Health District of Baltimore consisted of two city wards containing 10,979 white families or households, including approximately 43,000 persons and 2,800 colored households, including 12,363 persons.[a] As far as the white population is concerned the district is considered as fairly representative of the localities in the City in which the wage-earning population live; that is, it contains some families in relatively poor economic circumstances, wage-earning families in moderate circumstances, relatively few families in the professional class, and no families that can be classed as wealthy. Consequently, the district cannot be considered as strictly representative of Baltimore as a whole but it is probably representative of the population which forms the greatest majority in the City.

There are three hospitals within the Eastern Health District and two contiguous to it. Each of these hospitals has an out-patient department. Approximately 150 private physicians practice regularly within the district. However, during the first year's study some 330 different private physicians served the observed population.

DATA AND METHOD OF STUDY

The method of sampling in this particular study differed from that of previous periodic surveys. City blocks rather than streets formed the sampling units. Data showing the number of white and colored households in each square block in the district had been secured in a census made in 1933 by the Department of Biostatistics of the Johns Hopkins School of Hygiene, with the assistance of the Baltimore City Health Department. Since it was desired to limit the sample to around 1,500 families and yet have

[a] A few months after the special study of illness was started, the Eastern Health District was enlarged so that it now includes a population of approximately 100,000. Any reference to the Eastern Health District in this paper, however, is to the former district composed of Wards 6 and 7.

it representative of the population from which it was drawn, the census of families by square blocks made it possible to estimate the number of blocks needed to give the desired number of families. Entire city blocks in each of the ten census tracts were selected by picking square blocks roughly according to a checker-board pattern. An effort was made to select a sufficient number of blocks from each census tract so that the sample drawn from each tract would constitute the same percentage of the total sample population as the white population of that census tract was of the white population of the entire Eastern Health District. A total of thirty-five square blocks was selected in this manner. All of the white families in these blocks, except those families where cooperation in giving information was refused, formed the sample population.

The plan of the study was to follow white families that live in a group of houses in certain blocks rather than to follow a selected group of families. No attempt was made to continue visiting families that moved out of these houses during the period of the study, but the new families that moved into the houses vacated in the sample blocks were included in the study.

It was considered important to secure illness records from the families at fairly frequent intervals. Past experience had led to the belief that monthly visits would yield more accurate reports of illness than would visits at longer intervals of time and that with this plan fewer of the minor cases of sickness would be missed. Consequently, monthly visiting was initiated in this study. The record of illness started with the first visit to the family; no attempt was made to secure a report of illnesses which had occurred during a period preceding the first visit unless they were present at the time of the first visit.

In the studies of illness conducted by periodic canvasses of families "illness" is usually understood as any affection or disturbance of health which persists for a considerable part of one or more days. However, no definition of illness is imposed or set up from without

the study. The records of "illness" obtained in this study are of sicknesses reported by the household informant (usually the housewife), either as experienced by herself or as she observed them in her family. Defects or impairments were included as illness only when reported as disabling. Illnesses present in the family at the time of the first visit were recorded and considered as illnesses occurring within the period of the study. Illnesses in this class, with onset of illness prior to the beginning of the study, constituted 15 per cent of the total illnesses recorded during the course of a twelve-month period.

In order to make the sickness record more objective and thus increase the accuracy of information, a form was devised for recording on a calendar basis the onset and duration of cases of illness, the onset and duration of disability, the number of days confined to the house, the number of days confined to bed, and the number of days in the hospital. Also a special calendar containing sufficient space for recording illness on any day of the month was given to each family with the hope that it would aid in keeping an accurate record of illnesses which occurred in the family during the interval between the monthly visits.

The problem of obtaining a more accurate and complete picture of the extent of chronic disease in an observed population has been one of the particular concerns of the study in the Eastern Health District. At the time of the first visit to the family a special effort was made to record all cases of illness of a chronic nature among the present members of each household, whether or not they were causing present disability. Careful inquiry was made also concerning members of the family at that time resident in institutions for the insane, for the feeble-minded, for the tuberculous, and for other chronic diseases requiring institutional care.

In addition to the record of illness, families have been asked to report all preventive medical care, such as immunizations and vaccinations, health examinations, check-up examinations for chronic

disease, such as diabetes, prenatal and well-baby care, and desensitization treatments for asthma or hay fever. Also, a record of all eye care and of all dental care has been secured.

For all cases of illness and for cases of preventive medical care a record was made of the nature of medical service received and whether rendered by a private physician, clinic, or hospital. Forty-five per cent of the illnesses had medical care. The causes of illness as reported by the family informants were submitted to the attending physicians for confirmation or correction. The causes of illness for clinic attendance and hospital admissions were also checked against the records of the clinic or hospital where the service was given.

INCIDENCE OF ILLNESS, NUMBER OF SICK DAYS, AND MORTALITY

The data presented in this report include the sickness record for 1,796 families observed two months or longer during a twelve-month period ending June 22, 1939. Twenty-seven per cent of the 1,796 families observed two months or longer either moved out of or into the study area within the twelve-month period and were observed for periods varying from two to eleven months. The average period of observation for the 492 moving families was six months.[8] Included in the total of 1,796 families are 61 families which

[8] During the twelve-month period May 23, 1938 to June 22, 1939 a total of 2,127 different families were observed for varying periods of time. Approximately 40 per cent of these families either moved out of or into the study area during the year. One hundred and twenty-one, or 6 per cent, of the total families were dropped from the study at their own request. On the first canvass of the families less than 1 per cent of the total white families living in the houses in the sample blocks refused to cooperate and take part in the study. It is believed that the rate of refusals during the first year of the study of illness has not been high enough to introduce any particular bias into the observed population.

The moving rate for families in the sample blocks was fairly uniform month by month; the monthly rate averaged 3.2 per cent per month. An annual lease is not required for houses available for renting in the district. Rents are on a weekly or monthly basis. There is apparently no annual or seasonal migration of families either into or out of the district. At the present it is impossible to determine whether or not migration of families in the sample blocks is representative of the district as a whole. However, a special study of the movement of families within the district and in and out of the district is being conducted by the Department of Biostatistics of the Johns Hopkins School of Hygiene. When the results of this study are available it will be possible to compare the migration in the sample area with that among white families in the entire district.

(Continued on page 10)

Age	Sample Population (White Families)	Total White Population in Eastern Health District 1936	Sample Population[1] (White Families)	Total White Population in Eastern Health District 1936[2]
	per cent		number	
All Ages	100.0	100.0	5,648	43,781
Under 1 Year	1.2	1.4	70	605
1– 4	5.5	5.3	313	2,311
5– 9	7.4	7.9	410	3,444
10–14	8.6	9.6	487	4,198
15–19	9.7	10.0	549	4,378
20–24	9.4	10.0	529	4,378
25–29	9.4	8.9	533	3,887
30–34	9.2	7.4	520	3,227
35–44	14.7	14.7	833	6,432
45–54	12.0	11.8	680	5,160
55–64	7.4	7.2	411	3,166
65+	5.5	5.8	313	2,546
Unknown Age			51	49

[1] Years of life.
[2] Obtained from the records of unpublished data collected by the National Health Survey and analyzed in cooperation with the Johns Hopkins School of Hygiene.

Table 1. Age distribution of the sample population in thirty-five blocks in the Eastern Health District of Baltimore, compared with the total white population in the District.

were observed less than twelve months because they asked to be dropped from the study. The population for the twelve-month period includes 6,709 individuals with 5,699 years of observation.[4]

Representativeness of the Sample Population. It is possible to test the representativeness of the sample population in respect to certain characteristics of the total white population in the district. The age distribution of the population in the 1,796 families compared with the age distribution of the total white population of the Eastern Health District in 1936 is shown in Table 1.[5] It is readily

In the group of 2,127 families observed for varying periods of time there were 331 which had less than two months' observation. These families have been excluded from this analysis.

[4] Eighty-nine one-person families are included in the total population, also 146 individuals not related to the family but living in the household are included.

[5] Data for the entire Eastern Health District were obtained by the National Health Survey conducted by the United States Public Health Service in 1936.

apparent that there are no important differences between the sample population and the total white population with respect to age content. The average size of white household in that year for the total district, 3.9 persons per household, was the same as noted in the sample population in the thirty-five blocks studied during 1938-1939.

The proportion of white families owning their homes was somewhat lower in the sample of 1,796 families than in the district as a whole. Fifty-two per cent of the 1,796 families was classified as home owners and 48 per cent as renters, compared with 60 per cent and 40 per cent, respectively, in these classes in the district. This difference with respect to home-ownership is due to the fact that inclusion of moving families, those moving out of the study and those moving into the study, tends to weight the sample with families classed as renters. When the sample population is corrected for this factor by including only the families that moved out of the sample area and excluding those that moved into the area after the study was started the proportion of home owners and renters is the same for the sample area as for the district as a whole; 60 per cent was classed as home owners and 40 per cent as renters.[6] It may be concluded that the sample population is representative of the white population of the district from which it was drawn with respect to age constitution, size of household, and home-ownership.

Incidence of Illness. Table 2 shows the incidence of all illness, sole or primary causes only, and of disabling illness for the 1,796 canvassed families. Disabling illness was illness which caused loss of one or more days during the study year from work, school, or other usual activities or caused confinement to the house for one or more days.[7] A total of 1,268 illnesses from all causes per 1,000 popu-

[6] The 1936 survey represents the population with respect to home owners and renters at a given moment in time. In order to compare these characteristics of the sample population with the entire district, the sample population must also represent a given moment in time, rather than the flow of families within a year's period.

[7] "Confinement to the house" was a classification of disabling illness added to this study

(Continued on page 12)

Classes of Illness	Rate Per 1,000 Population	Number of Cases of Illness
All Illness	1,268	7,228
Disabling Illness[2]	572	3,251
"Confined to House"	512	2,916
"Confined to Bed"	332	1,892
"Confined to Hospital" (Including Institutional Cases)	67.4	384
"Confined to Institution"	3.9	22

[1] The population includes 5,699 years of life (all ages and both sexes) in 1,796 white families observed two months or longer.

[2] Causing loss of one or more days from school, work, or other usual activities, or causing one or more days' confinement to the house.

The classifications of disabling illness are not mutually exclusive of one another. For example, illnesses classed as "confined to house" include all bed illnesses, all hospital illnesses, and all other illnesses which caused the patient to be confined to the house.

Table 2. Incidence of illness in 1,796 canvassed white families in the Eastern Health District of Baltimore during twelve consecutive months, 1938-1939.[1]

lation, or slightly more than one illness per person, was reported during the twelve-month period. The rate of disabling illness, 572 per 1,000 population, was less than half the total illness rate. Most of the illnesses which caused disability also caused confinement to the house. The rate for illnesses in this class was 512. Illnesses causing the patient to spend one or more days in bed occurred at the rate of 332 per 1,000 population. Bed illness includes hospital and institutional cases of illness; however, the rate of hospitalization, 67 per 1,000, was only about one-fifth of the total rate for illnesses confining the patient to bed. Institutional cases with a rate of 3.9 per 1,000 population formed a very small proportion of the total hospital cases.[3]

The total illness rate observed in the sample population in the Eastern Health District of Baltimore was considerably higher than the rate observed in 9,000 families in eighteen states studied by the Committee on the Costs of Medical Care and the United States

to cover a type of disability which the ordinary definition of disabling illness did not cover. For example, a school-age child may be ill during the summer when interference with school because of illness does not apply. If the child was ill enough to be kept in the house, but not necessarily in bed, he was considered as disabled.

[3] Institutional cases include individuals in State, Federal, or private institutions for the insane, for the feeble-minded, for epileptics, for the tuberculous, and for orthopedic cases.

Public Health Service. The total illness rate for the 9,000 families was 850 per 1,000 population. The rate for the 1,796 canvassed families in Baltimore adjusted to the age distribution of the population in the Committee on the Costs of Medical Care study was 1,407 per 1,000 population. The rates for disabling illnesses were fairly similar in the two studies; 680 per 1,000 population (adjusted for age) in the Eastern Health District study, compared with a rate of 516 for the 9,000 families in the Committee on the Costs of Medical Care study.[9] In the Committee on the Costs of Medical Care study, each family was visited at intervals of two to four months for a period of a year. In Baltimore each family was visited each month, thus insuring more accurate reporting of minor illnesses.

The illness rate in the Eastern Health District study was also somewhat higher than the rate for the Hagerstown study, which was 1,081 per 1,000 population.[10] However, the rate for cases confined to bed, 332 per 1,000 population, for the families in Baltimore was less than the rates for bed cases in both the Hagerstown and the Committee on the Costs of Medical Care study, which were 432 and 434 per 1,000, respectively.

More frequent visits to the family account for some of the difference in the rate of illness in the Eastern Health District compared with the rates noted in the Committee on the Costs of Medical Care study and in the Hagerstown study. Unpublished data from a morbidity study made in Syracuse, New York, by the United States Public Health Service in cooperation with the Milbank Memorial Fund, has made it possible to show the occurrence of illnesses in relation to the time of the visit to the family. The rate for illness from all causes which occurred within the first month prior to the enumerator's visit was 1,272 per 1,000 population. This rate is

[9] Collins, Selwyn D.: Causes of Illness in 9,000 Families Based on Nation-Wide Periodic Canvasses, 1928-1931. *Public Health Reports,* United States Public Health Service, March, 1933, 48, No. 12.

[10] Sydenstricker, Edgar: A Study of Illness in a General Population Group. *Public Health Reports,* United States Public Health Service, September 24, 1926, 41, No. 39, p. 2069.

strikingly similar to the rate of 1,268 which was obtained through regular monthly visiting in the Eastern Health District of Baltimore. In the Syracuse study the rate for illnesses which occurred two, three, or four months prior to the enumerator's visit ranged from 540 to 631 per 1,000 population and were less than half the

Table 3. Number and rate of days of illness from all causes according to classification of disability in 1,796 white families in the Eastern Health District of Baltimore during twelve consecutive months, 1938-1939.[1]

Classes of Sick Days	Sick Days Per 1,000 Population	Number of Sick Days
All Sick Days	69,357	395,271
Non-Disabled Sick Days	54,263	309,249
Sick Days Due to Year-Long Cases with No Disability[2, 4]	25,695	146,438
Disabled Sick Days	15,094	86,022
Sick Days Due to Cases Disabled Throughout the Year[3, 4]	5,060	28,835
Confined-to-House Sick Days	9,167	52,240
Sick Days Due to Cases Confined to House Throughout the Year	2,050	11,680
Bed Sick Days	4,964	28,288
Sick Days Due to Cases Confined to Bed Throughout the Year	1,089	6,205
Hospital Sick Days (Including Institutional Sick Days)	2,093	11,928
Sick Days Due to Cases Confined to Hospital Throughout the Year	769	4,380
Institutional Sick Days	1,064	6,066
Sick Days Due to Cases Confined to Institution Throughout the Year	769	4,380

[1] The population included 5,699 years of life.
[2] The diagnoses of the year-long non-disabling cases included cases of heart disease, high blood pressure, rheumatic heart and chorea, tumor, goiter, syphilis, diabetes, nervousness, asthma, chronic nephritis, chronic bronchitis, menstrual disorders including menopause, hernia, anemia, varicose veins, and low blood pressure.
[3] The diagnoses of the year-long disabling cases included cases of cancer, rheumatic fever and chorea, diabetes, arthritis, paralysis, tuberculosis, nephritis, varicose veins, heart and high blood pressure, nervous and mental cases, epilepsy, ulcers of stomach, total blindness, amputation, and accidents.
[4] In addition, year-long cases with some days of disability but not disabled throughout the year accounted for 15,400 non-disabled sick days or a rate of 2,702 per 1,000, and 3,215 disabled sick days, or a rate of 564 per 1,000 population.

rate for illnesses which were reported for the first month prior to the visit to the family. The illness rates cited from the Syracuse study are corrected for season, that is, they represent averages of rates for four three-month periods during the year ending June 30, 1931. It may be concluded that fairly frequent visiting of families does result in greater completeness and accuracy in the reporting of illness.

The Number of Sick Days. Illness for a population can also be presented in terms of the days of sickness per year. Table 3 presents the total days of illness according to non-disabling sick days and classes of disabled sick days. The number of sick days for year-long cases is also shown for each class of sick days. There were sixty-nine sick days per person and fifty-four of these were non-disabled sick days. Forty-five per cent of the total cases of illness were classified as disabling and these illnesses caused fifteen days of disability per person or a rate of 15,094 disabled days per 1,000 population. Disabling illness classed as "confined to the house" caused 9.2 sick days per person per year, or a rate of 9,167 per 1,000 population.

Fifty-eight per cent of the disabling cases were confined to bed for one or more days. There was an annual total of five days in bed per person. Hospital cases formed only 5 per cent of the total cases of illness reported during the year and 12 per cent of the disabling cases of illness. Hospital cases were responsible for 42 per cent of the bed days of illness. The annual number of hospital days was 2,093 per 1,000, or two days per person.[11]

Individuals in institutions accounted for a relatively high proportion of hospital days. Six per cent of the hospital cases were institutional cases, but since each case in an institution throughout the year counted as 365 hospital days, a small number of such cases has a marked effect upon the total. Of the total hospital days of

[11] Computations based on the American Medical Association report on hospitals (March 11, 1939) indicate that for the year 1938 there were 2,707 days of hospital care annually per 1,000 population in the United States. The annual rate of hospital admissions was 72.4 per 1,000 population.

illness, 51 per cent were institutional days. The number of institutional days was one per person per year, or 1,064 per 1,000 population.[12]

That the year-long cases have a marked effect upon the total sick days is plainly evident from Table 3. Approximately half of the non-disabled sick days were due to cases continuing throughout the year. One-third of the total disabled days were due to illnesses which caused disability throughout the year. Year-long cases accounted for slightly less than a fourth of the sick days classed as "confined to the house"; and one-fifth of the bed days was due to cases continuing for a twelve-month period. Such cases accounted also for a third of the hospital days.

Mortality. The population in the 1,796 families suffered a mortality of 10.0 per 1,000 during the twelve-month period. The death rate in these families was only slightly lower than the resident rate, 11.0 per 1,000 for white persons in the district.

ILLNESS AMONG MIGRANT AND NON-MIGRANT FAMILIES DURING A TWELVE-MONTH PERIOD

The fact that 27 per cent of the total 1,796 families studied was classed as "moving" families, that is, they either moved out of the study area or moved into the study area during the first twelve months, and were observed for varying intervals of time, introduces a special problem in the analysis of the incidence of illness among their population. The respiratory diseases and some of the acute communicable diseases of childhood have a definite seasonal incidence; on the other hand, it is generally believed that the incidence of the chronic diseases does not vary with season. Generally, studies of illness have been planned so as to take account of the effect of season by including a full calendar year of observation for all families studied. This has meant, however, that illness in the migrant or

[12] Patients in mental and nervous hospitals accounted for 4,377, or 72 per cent, of the total 6,066 institutional days; tuberculosis hospitals accounted for 22 per cent, or 1,324 institutional days. The remaining 365 institutional days were due to a patient in a special hospital because of disability from infantile paralysis.

moving family has not been observed, except in the single visit survey. Since the moving rate of the 492 families which moved into or out of the sample population during the study year was fairly regular, month by month, any undue influence of season is minimized and it is possible to utilize the observation of these part-time families for the study of illness among them.

The 492 migrant families were generally similar to the 1,243 families that did not move during the twelve-month period with respect to the distribution by employment status of the heads of the household and of persons of employable age, and by income class, for those where income was known. However, as might be expected, the proportion of families renting homes was considerably greater among the migrating group as compared with the families which did not move; in the former group the proportion of renters was 87 per cent and in the latter, 34 per cent. The age distribution of the population in the two groups of families was somewhat different. On the whole, the moving group was composed of younger families; the heads of the families were mainly persons under 50 years of age and there was a somewhat higher proportion of children under 10 years of age in those families than was true of the non-migrating families.

Table 4 shows the illness rates, the mortality rates, and the hospitalization rates for the 1,243 families that did not migrate or move from the study area during the twelve-month period, May 1938 to June 1939, and the rates for the 492 families that did move.[13] The illness rate for all causes except confinements (adjusted for age), 1,522 per 1,000 population, noted for the group of migrating families, is 26 per cent in excess of the adjusted rate, 1,213, recorded for the families that did not move during the period[14] under considera-

[13] The sixty-one families observed less than twelve months because of refusal to cooperate have been excluded from this analysis.

[14] There was in the population of the migrating families a slight weighting during the winter months when the acute respiratory diseases are more prevalent. The data were tested

(Continued on page 18)

Classification of Incidence	Families That Did Not Migrate During 12 Consecutive Months	Families That Moved Into or Out of the Study Area During a Period of 12 Consecutive Months
	Rate per 1,000 population	
All Illness		
All Causes		
Crude Rate per 1,000 Population	1,216	1,603
All Causes Except Confinements		
Crude Rate per 1,000 Population	1,207	1,590
Adjusted Rate per 1,000 Population[2]	1,213	1,522
Hospitalized Illness		
Rate per 1,000 Population		
Excluding Institutional Cases	57.3	99.9
Including Institutional Cases	61.1	104.5
Mortality (All Causes)		
Rate per 1,000 Population	9.5	12.6
	Number	
Years of Life	4,743	871
Cases of Illness	5,768	1,396
Number of Hospital Admissions Excluding Institutional Cases	272	87
Number of Hospital Admissions Including Institutional Cases	290	92
Number of Deaths	45	17

[1] Based on families observed two months or longer.
[2] Rate adjusted to the age distribution of the total population of the migrant and non-migrant families.
The confinement rate per 1,000 females aged 15–44 was 54.0 for those who did not move during the year, and 98.8 for those who did move.

Table 4. Incidence of illness, mortality, and hospitalization in 1,735 canvassed families (moving and non-moving families) in the Eastern Health District of Baltimore during twelve consecutive months, 1938-1939.[1]

tion. Likewise, the mortality rate, 12.6 per 1,000, among the migrating population was considerably higher (33 per cent) than that recorded for the non-migrating families, where the rate was 9.5 per

for this factor by a comparison of the attack rate from respiratory diseases by three-month periods in the two groups of families. The excess in the attack rates for the moving population was noted in each of the quarters of the year.

1,000 population. The difference in the rate of hospitalization is even more striking; the rate of 100 in the group which moved into or out of the study area is 75 per cent higher than the rate of 57 per 1,000 in the non-migrating families. The rate for institutional cases is similar for both groups and when these cases are added to the other hospital admissions, the relationship between the rates noted for the two groups of families remains the same as when institutional cases are excluded.

The only other data revealing illness in a moving population are based upon employed males and are not strictly comparable with the data from the Eastern Health District of Baltimore. Brundage has shown the frequency of illness, including non-industrial accidents, causing absence from work for one day or longer among employees of a rubber company during a two-year period and according to the length of service with the company. A considerably higher illness rate was noted among persons employed less than six months, where the annual rate was approximately 2,500 per 1,000 employees contrasted with a rate of 1,228 among those employed from one to five years.[25] The inference from these data is that illness *per se* may be a factor affecting labor turn-over or the length of the period of employment.

The data for the moving families in the Eastern Health District are small in number but it is of interest to point out the fact that 67 per cent of the total 1,877 individuals in these families reported one or more illnesses during the period of observation. On the other hand, only 49 per cent of the 4,921 individuals in the non-moving families reported one or more illnesses during the year. This is of special significance in view of the fact that the 1,877 individuals in the moving families were observed on the average only six months; the average period of observation for the 4,921 individuals in the non-moving group was 11.6 months.

[25] Brundage, Dean K.: The Incidence of Illness Among Wage-Earning Adults. *The Journal of Industrial Hygiene*, November, 1930, xii, No. 9.

It is of interest to examine the rates by cause for all illnesses and disabling illnesses in the migrant families and the non-migrant families. These data are shown in Tables 5 and 6. An excess in the illness rate among the migrant families was noted for most causes of illness. Exceptions to this were noted in the illness rate from rheumatic fever, and in the rate for the total degenerative diseases, which was somewhat higher in the non-migrant families compared with the migrant group.

The rates, both for total illnesses and disabling illnesses, for minor respiratory, digestive diseases, female genital and puerperal causes, and for accidental injuries were decidedly higher among the population of the moving families compared with those that did not move. For example, the rate for female genital and puerperal causes, which includes confinements, was slightly more than twice as high among the moving families, 67.7 per 1,000, as among families which did not move, where the rate was 32 per 1,000 population.

It is recognized that the years of life observed in the 492 families forms too small a population for definite conclusions to be drawn on the basis of their experience. Nevertheless, the fact that excesses in the rate of illness, of hospitalization, and of mortality were all noted in the migrating families contrasted with those that did not migrate, is of considerable interest and may be indicative of a significant difference between the two groups with respect to illness and its consequences. At least it seems advisable to continue to observe migrating families so that more experience concerning them may be accumulated.

INCIDENCE OF NEW CASES OF CERTAIN CHRONIC DISEASES

As stated before, the investigation of the chronic diseases was of major interest in the study of illness in the Eastern Health District of Baltimore. Special information was sought for all cases of a chronic nature. This special information included data concerning the onset of the first symptoms of the disease, their nature and date;

Cause of Illness with International List Numbers, 1920 Revision	Rate Per 1,000 Population[1]			
	Total Illness		Disabling Illness	
	Non-Migrant	Migrant	Non-Migrant	Migrant
All Causes	1,212.7	1,599.3	543.3	748.6
Minor Respiratory Diseases (11, pt. 97, 98, 99, pt. 107, pt. 109)	548.2	766.9	216.3	322.6
Other Respiratory Diseases (31, pt. 97, 100–106, pt. 107, pt. 109)	58.0	49.3	32.5	22.9
Minor Digestive Diseases (15, pt. 16, 112–114)	72.5	91.8	39.0	48.2
Other Digestive Diseases (pt. 108, 110, 111, 115–127)	41.5	72.3	21.9	47.1
Communicable Diseases (1–10, 12–14, pt. 16, 17–30, 32–42)	58.6	82.6	47.8	68.9
Ear and Mastoid Diseases (86)	11.4	26.4	5.3	19.5
Nervous Diseases except Cerebral Hemorrhage, Paralysis, Neuralgia, and Neuritis (70–73, 76–80, 84)	25.7	21.8	12.9	8.0
Acute Rheumatic Fever and Chorea (pt. 51, 81)	8.0	4.6	4.8	2.3
Rheumatism and Related Diseases (pt. 51, 52, 82, pt. 158)	39.4	40.2	16.2	11.5
Degenerative Diseases (43–50, 57, 74, 75, 83, 87–92, pt. 93, pt. 96, 128, 129, 130, pt. 131, 132, pt. 133, 135)	86.9	81.4	42.6	41.1
Skin Diseases (151–154, pt. 205)	27.8	42.5	7.0	12.6
Female Genital and Puerperal Diagnoses (137–150)	32.0	67.7	21.7	51.7
Accidental Injuries (pt. 85, 165–203)	94.7	124.0	44.2	54.0
All Other Diseases	107.9	128.6	31.0	39.0

[1] Sole or primary cause only.

Table 5. Incidence of total illness and disabling illness by certain causes among migrant and non-migrant families in the Eastern Health District of Baltimore during twelve consecutive months, 1938-1939.

Causes of Illness with International List Numbers, 1920 Revision	Number of Cases of Illness[1]			
	Total Illness		Disabling Illness	
	Non-Migrant	Migrant	Non-Migrant	Migrant
All Causes	5,752	1,394	2,577	653
Minor Respiratory Diseases (11, pt. 97, 98, 99, pt. 107, pt. 109)	2,600	668	1,026	281
Other Respiratory Diseases (31, pt. 97, 100–106, pt. 107, pt. 109)	275	43	154	20
Minor Digestive Diseases (15, pt. 16, 112–114)	344	80	185	42
Other Digestive Diseases (pt. 108, 110, 111, 115–127)	197	63	104	41
Communicable Diseases (1–10, 12–14, pt. 16, 17–30, 32–42)	278	72	127	60
Ear and Mastoid Diseases (86)	54	23	25	17
Nervous Diseases except Cerebral Hemorrhage, Paralysis, Neuralgia, and Neuritis (70–73, 76–80, 84)	122	19	61	7
Acute Rheumatic Fever and Chorea (pt. 51,81)	38	4	23	2
Rheumatism and Related Diseases (pt. 51, 52, 82, pt. 158)	187	35	77	10
Degenerative Diseases (43–50, 57, 74, 75, 83, 87–92, pt. 93, pt. 96, 128, 129, 130, pt. 131, 132, pt. 133, 135)	412	71	202	36
Skin Diseases (151–154, pt. 205)	132	37	33	11
Female Genital and Puerperal Diagnoses (137–150)	152	59	103	45
Accidental Injuries (pt. 85, 165–203)	449	108	210	47
All Other Diseases	512	112	147	34

[1] Sole or primary cause only.

Table 6. Number of cases of all illness and disabling illness by certain causes among migrant and non-migrant families in the Eastern Health District of Baltimore during twelve consecutive months, 1938-1939.

the date of the first diagnosis, and whether or not the diagnosis was made by a private physician, at a clinic, or at a hospital. Also, for each case of chronic disease, data were secured concerning disabling attacks which occurred previous to the time of the special study of illness. Such a record has made it possible to observe the occurrence of new cases of chronic disease which were manifest by illness sufficiently severe to obtain a diagnosis. Through the ordinary study of illness in a canvassed population it is, of course, impossible to observe the incidence of chronic disease in its minimal state, that is, before symptoms cause the patient to seek a diagnosis. However, it is believed that it is of interest to attempt to determine the rate at which manifest illness from the chronic diseases occurs.

Table 7 shows the prevalence of certain of the chronic diseases in the population at the time the families first came under observation, and the incidence of new cases of such diseases within the study year. The diseases are classified according to those not considered as necessarily associated with the ageing process and those which may be considered as degenerative diseases. In the first group, rheumatism and arthritis were most prevalent, with a rate of 11.8 cases per 1,000 population. Rheumatic fever ranked next in importance, with a rate of 4.0 cases per 1,000 population; approximately three-fourths of these cases were classed as rheumatic heart disease. At the time of the first visit there were present in the population 2.2 cases of active tuberculosis per 1,000.

The total prevalence of the degenerative diseases was 40 cases per 1,000 population. Diseases of the heart and arteries were the most prevalent; the rate was 23 cases per 1,000 population. The prevalence of the other degenerative diseases varied from 1 case of cancer per 1,000 population to 5.5 cases of diseases of the kidneys.

The annual incidence of new cases of the diseases of a chronic nature corresponded roughly with their prevalence, in that generally those with the highest prevalence occurred at the greatest rate. In the group of non-degenerative diseases the incidence of new

Diagnosis Group	Prevalence of Cases of Disease with Onset Prior to First Visit[1]	Incidence of New Cases of Disease Manifest by Illness[2]
	Rate per 1,000 population	
Rheumatism and Arthritis	11.8	7.9
Active Tuberculosis	2.2	1.1
Rheumatic Fever	4.0	0.9
Rheumatic Heart	2.8	0.4
Degenerative Diseases	40.2	22.6
Cancer	1.0	1.2
Tumors	2.2	3.3
Diabetes	3.7	0.7
Diseases of Heart, Arteries and Cerebral Hemorrhage	22.7	8.2
Other Circulatory	3.6	3.9
Diseases of Kidneys	5.5	2.8
Diseases of the Bladder	1.5	2.6
	Number of cases	
Rheumatism and Arthritis	79	45
Active Tuberculosis	15	6
Rheumatic Fever	27	5
Rheumatic Heart	19	2
Degenerative Diseases	270	129
Cancer	7	7
Tumors	15	19
Diabetes	25	4
Diseases of Heart, Arteries and Cerebral Hemorrhage	152	47
Other Circulatory	24	22
Diseases of Kidneys	37	16
Diseases of the Bladder	10	15

[1] Based on 6,709 individuals.
[2] Based on 5,699 years of life.

Table 7. Prevalence of cases of certain chronic diseases in 1,796 canvassed families in the Eastern Health District of Baltimore when first visited and incidence of new cases of certain chronic diseases during twelve consecutive months, 1938-1939.

cases of rheumatism and arthritis, those without a history of ever having had the disease or condition before, was 7.9 per 1,000 persons

per year. New cases of active tuberculosis occurred at the rate of 1 per 1,000 and the annual rate for new cases of rheumatic fever was slightly less than 1 per 1,000 population.

The incidence for the total group of degenerative diseases was 23 cases per 1,000 population; in this group new cases of diseases of the heart (excluding rheumatic heart disease) and arteries and cerebral hemorrhage occurred at the highest rate, 8.2 per 1,000 population. The annual incidence of the other diseases in the degenerative group ranged from 1.2 cases of cancer per 1,000 population to 3.9 cases of diseases of the circulatory system, other than those of the heart and arteries.

Very little is known about the incidence of the chronic diseases or their fatality. No claims are made that the rates of incidence obtained in this study have absolute value in themselves. Rather, it is believed that when more data are accumulated they may give some indication as to the annual rate at which new cases of these specific diseases are manifesting themselves. All of these diseases are of a chronic and disabling nature. The two factors, incidence and duration to mortality or recovery, determine the prevalence of these diseases in a given population at a given period of time. Since the chronic diseases are fast becoming a major public health problem, it will be of considerable practical value to increase our knowledge concerning their frequency of occurrence in a population, their duration in terms of disability, bed, and hospital care, and their fatality. Such information will form the basis for estimating the need and planning for the provision of facilities for the care of those suffering from chronic disabling disease.

SUMMARY

This is a preliminary report of a year's experience of illness for a sample of the white population drawn from the Eastern Health District of Baltimore, which is to be kept under observation for several years. It is appropriate, therefore, to emphasize the objectives and methods of the study rather than the specific findings.

The objectives of this special study are to gain more exact knowledge concerning the maximum amount of illness in a population and to investigate particularly the chronic diseases. Improved techniques of studying illness and its effects are being employed in order to attain these objectives. The improved techniques include: more frequent visits to the families, a form for more exact recording of duration of illness, of disability, of bed, and of hospital days.

The moving or migrant families which are not usually included in periodic surveys of illness have been included in this study. The fact that they suffered a higher rate of illness from all causes, a considerably higher rate of hospital illness and of mortality than did the non-moving families, in spite of the fact that in certain respects the two groups of families were generally similar, may be considered as denoting that there are important differences between the two groups of families with respect to illness and its consequences which are worthy of continued study.

A beginning in the study of the incidence of new cases of the diseases which tend to be chronic has been made. Information concerning their frequency of occurrence, their duration in terms of total illness, of disability, bed, and hospital care is needed in order to provide proper and adequate facilities for persons suffering from chronic disabling disease.

POPULATION AND THE PATTERN OF UNEMPLOYMENT, 1930-1937

RUPERT B. VANCE AND NADIA DANILEVSKI[1]

THE problem of unemployment presents many facets of interest to students of population trends. It is reasonable to suppose, for example, that in a contracting economy reciprocal relations of cause and effect may exist between population increases and increased unemployment. Thus a recent paper by T. J. Woofter, Jr., in the *Quarterly* furnishes presumptive evidence that natural increase in the rural farm population aged 18 to 65 years will lead to greater unemployment unless we have an expanding economy.[2] Conversely, prolonged unemployment itself is likely to have adverse effects on population increase. Presumably such effects may be related to the fact that the whole population comes to be supported by a smaller proportion of the total group engaged as a working force. Moreover, changes in the age and sex ratios of both employed and unemployed workers may be expected to affect population increases and thus in turn affect population policy. In a large sense our policy in relation to unemployment and reemployment might in time come to be regarded as part of a national population policy.

Any discussion of these problems would benefit from an analysis of the pattern of employment and population as they developed during the depression. For this purpose we must make use of the regular Census of 1930 and the Special Unemployment Census of 1937. The enumerative check census of the 1937 Special Unemployment Census applies age and sex distribution to the pattern of the

[1] From the Study of the Southern People, a project of the Institute for Research in Social Science, University of North Carolina.

[2] Woofter, T. J., Jr.: Replacement Rates in the Productive Ages. The Milbank Memorial Fund *Quarterly*, October, 1937, XV, No. 4, pp. 348-354.

employed, the unemployed, and those unavailable for gainful employment among the adult population, aged 15-74.[3]

In order to throw light on increasing unemployment during the depression this paper adjusts the 1930 and 1937 censuses of unemployment to a comparable basis in the attempt to estimate changes due: (1) to population increases, and (2) the changes in social-economic conditions.

SOURCE AND RELIABILITY OF DATA

Such use of the 1937 Census involves some judgment as to its reliability. Presumably the Census has as yet been put to little use by students of population, largely because of doubts of its reliability. In regard to the voluntary registration of the unemployed secured by postal card returns, these doubts seem to be justified. To supplement and check these data, however, an enumerative check census was made of 2 per cent of the postal routes, covering 1.5 per cent of our total population. Conducted by regular mail carriers, this registration covered 1,640 check areas, containing a total of 1,950,000 persons of both sexes and all races, and selected as representative of the 82 per cent of our population who are reached by postal delivery service. This enumeration represents the first use the Census has made of the sampling technique on a national basis, and the Bureau of the Census accompanied each important estimate made from the sample data by a statement of its validity. Within the postal delivery areas a high degree of accuracy was attained.[4]

In extending the estimated totals of employed, unemployed, and unavailable to include the non-delivery areas this high degree of accuracy is not maintained. In the final estimate of the distribution

[3] Biggers, John D.: CENSUS OF PARTIAL EMPLOYMENT, UNEMPLOYMENT, AND OCCUPATIONS, Volume IV. The Enumerative Check Census. By Calvert L. Dedrick and Morris H. Hansen. Washington, Government Printing Office, 1938.

[4] Thus the estimated percentage of males available for employment is 85.6 with fiducial limits of $\pm$ .4. In this case the chances are 99 to 1 that the difference between the estimate of 85.6 per cent and the true percentage in all areas having postal delivery service would lie between 85.2 and 86.0 per cent (*See* Table A in the Appendix).

by functional class (Volume IV, Table VI, p. 20), percentages have been adjusted to allow for differences in age and sex composition between the population in the delivery areas and the total population in the nation. The number of unemployed in the final estimate was computed on the basis of the voluntary registration which included the non-delivery areas with corrections for completeness of registration. The remaining functional classes were computed from the data of the check census and from an independent estimate of the 1937 population by age and sex groups furnished by the Bureau.[5]

The facts justifying the use of the estimates for the total United States can be summed up as follows: (1) Computed sampling variations of estimates within the postal delivery area are very small. (2) For the three classes of unemployed the estimate was based in part on data including the whole population. (3) Adjustments were made to take care of age and sex differences between the total population and that of the non-delivery area. (4) Some of the errors due to omission of the non-delivery areas in the sample are self-compensating.[6] If used with due caution, the estimates of the sample census seem to be of sufficient validity to warrant analysis. "The most valuable achievement," writes Thomas C. McCormick, "of this unique experiment by the Census Bureau was probably to show that it is perfectly feasible to apply the method of sampling to certain kinds of census estimates."[7]

THE EFFECTIVE LABOR FORCE AND THE NATURAL DEPENDENTS, 1937

As the Special Census shows, the population aged 15-74 in 1937 presented a varied pattern of employment. Out of every ten men,

[5] Percentages by functional class were derived from data of the check census and applied to the total population of each age and sex group as given in the estimate. (*See* Vol. IV, p. 133, Ap. B., Method 2.)

[6] Vol. IV, p. 24, footnote 7.

[7] Thomas C. McCormick in a review in *American Sociological Review*, August, 1939, iv, pp. 613-615.

one was unable to work, and nine were employable. Of these nine only six or seven could get jobs while two or three were left unemployed or worked on WPA and other projects. Of every ten women, seven sat at home while three sought jobs, two of whom were successful. For the total population, four remained at home, six sought jobs, but only four could find them. Significant categories in this analysis are based on the concept of availability for employment for gain or profit. Those available constituted the labor force made up of two classes: the employed and the unemployed. The third class consists of those unavailable for gainful employment.[8] This economic classification cannot rightly be understood apart from consideration of age and sex distribution.

Age and sex distribution in any society sets the demarcation between the working force and the natural dependents—the young and the aged. Within the economically productive groups, age and sex distinctions also serve to distinguish between those in the labor market and those who do not seek gainful employment, as for example youth in school and busy housewives.

In depression it is realized that an increased proportion of the labor force is "wasted," leaving a smaller part of the population to support the whole group. Table 1 represents an attempt to answer the question: what portion of the available labor force was left unutilized or wasted? Part-time employed and partly unemployed are computed at half time and the ill and temporarily idle are counted with the totally unemployed. This procedure gives an estimate that somewhat less than one-fourth (23.8 per cent) of the nation's labor force was "wasted" in 1937.

Population students are also interested in finding out what proportion of the group "supports" the total population. This may be shown by including in our analysis (1) the natural dependents, those too young and too old to work, and (2) those who are not

[8] *See* Table A in the Appendix for figures and discussion of the three functional classes: employed, unemployed, and unavailable for employment.

seeking work, "the unavailables." In the nation 28.2 per cent of the total population are under 15 or over 75 and thus largely dependent, 10 per cent are "wasted" man-power, and 29.8 per cent are unavailable (Table 2). Thus in 1937 the total population of 129,533,000 was supported by 41,504,000 equivalent full-time workers, comprising only 32 per cent of the population.

Table 1. Per cent of total man-power 15-74 available for employment by functional class with per cent wastage of man-power, 1937.[1]

Functional Class	United States	
	Per Cent Man-Power	Per Cent Wastage
TOTAL AVAILABLE FOR EMPLOYMENT	100.0	23.8
Totally Unemployed	16.4	16.4
Emergency Workers	3.8	
Partly Unemployed	10.2	5.1
Part-Time Workers	2.2	1.1
Fully Employed	66.2	
Ill or Voluntarily Idle	1.2	1.2

[1] For sources and data see Table A in the Appendix.

Table 2. Distribution of population by effective man-power, 1937. (Estimate in thousands.)

Population Group	United States	
	Number	Per Cent
TOTAL POPULATION	129,533[1]	100.0
Workers (Full-Time)	*41,504*	*32.0*
Dependent	*88,029*	*68.0*
Wasted	12,970	10.0
Not Available: 15–74 yrs.	38,589	29.8
Under 15 and Over 75	36,470	28.2

[1] Corrected estimates of the United States Census Bureau for November 1, 1937; all other estimates derived from the United States Census of Partial Employment, Unemployment, and Occupations.

Traditionally the problem of the support of the total population by the working force has been met in the family. It was the family group which supported the unemployed and those unavailable for employment along with its natural dependents. Increasingly, economic insecurity has shifted the burden of support of the unemployed and the aged from the private to the public sphere. Once unemployment becomes affected with a public interest, society comes to watch with concern its maturing youth who, simply by

growing up, may make the transition from natural dependents to unemployed youth, a social responsibility. Important also in this connection are the large numbers classified as unavailable for employment. Almost 7,000,000 men and 32,000,000 women, 41.5 per cent of the population 15-74, were in this category in 1937 (Table A). For any number of them to seek work and fail to find it adds to our mounting figures of unemployed. In any society committed to the relief of unemployment this indicates that, unless they find work, the problem of their support has shifted from the private to the public sphere.

PRIMARY AND SECONDARY UNEMPLOYMENT, 1930-1937

With these considerations in mind we shall attempt to trace the change in numbers of workers by the three functional classes: unemployed, employed, and unavailable for employment from 1930 to 1937. Any increase in the amount of unemployment from one period to another may be due (1) to change in the number and composition of the population, and (2) to change in social-economic conditions. Changes in unemployment due to social-economic conditions can conceivably be explained from the point of view of (a) lost jobs or of (b) increased proportions of job-seekers among the population, 15-74.

In order to separate (1) the population factor from the (2) social-economic factor we have attempted to reduce the two Censuses to a comparable basis* and to compute the difference due only to change in population for each functional class. Thus to ascertain changes in the number of the unemployed due to change in age-sex-group composition, it was necessary to compute the 1930 age specific unemployment rates for each five-year age group, male and female, 15-74, and to apply these rates to the 1937 population distribution. The summation of these figures for each sex and for the total population gives us the amount of unemployment we

* Table B in the Appendix shows readjustments by sex and age groups needed to bring the 1930 and 1937 Censuses to a comparable basis.

should expect with 1930 employment held constant. The results summed up for all age groups[10] by functional class are presented in Table 3 by sex under the heading *Expected Number in 1937 with Conditions as of 1930*. Thus, for example, the expected number of totally unemployed of both sexes with social-economic conditions unchanged from 1930 is 2,641,000.

The results of this analysis for the three functional classes are shown in Table 3 and Figure 1. The first two rows (Table 3) show the adjusted number of workers in 1930 and 1937. The actual difference between the two sets of figures (third horizontal row) is due to the two factors: (1) change in number and composition of population, (2) change in social-economic conditions. In order to separate the effects of these two factors, we have computed the difference due only to change in population. Thus, column 3 shows that the total number of unemployed "expected" in 1937 is 2,641,000. Since the total number of unemployed in 1930 was 2,426,000 (*see* second horizontal line), the increase due only to change of population amounts to 215,000. The actual increase in the number of unemployed persons from 1930 to 1937 was 8,586,000. This represents the combined effect of population and social-economic changes. The net difference in unemployment, which can be attributed to change in social-economic conditions alone, is 8,586,000 minus 215,000, or 8,371,000.

Following this method for various functional classes and both sexes, we can state that the increase in unemployment from 1930 to 1937 was caused by a drastic change in conditions, since the surplus of unemployed due to population changes contributes but a negligible share of the total surplus. On the other hand, the total surplus in "all workers available" (category 2) of both sexes, or 7,682,000, was created almost equally by the effect of changed population (4,051,000)[11] and changed conditions (3,631,000). Analyzing this

[10] The method involves the same principle used in computing the standardized death rate.

[11] Of 4,051,000 increased population, it would appear (category 4) that 3,836,000 got jobs.

Item	Total Population Aged 15–74		Employed or Available for Employment						Unavailable for Employment	
			Total		Totally Unemployed		Employed (Fully or Partly)			
	1 (equals 2+5)		2 (equals 3+4)		3		4		5	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
A										
ALL										
Number in 1937	93,063	100.0	54,503	58.6	11,012	11.9	43,491	46.7	38,560	41.4
Number in 1930	84,805	100.0	46,821	55.2	2,426	2.9	44,395	52.3	37,984	44.8
Actual Difference	8,258		7,682		8,586		−904		576	
Exp. No. in 1937[1]	93,063		50,872		2,641		48,231		42,191	
Surplus over 1930 Due to Increase in Pop. 15–74	8,258		4,051		215		3,836		4,207	
Net Difference	0		*3,631*		*1,971*		*−4,740*		*−3,631*	
B										
MALE										
Number in 1937	46,704	100.0	40,115	85.9	7,533	16.1	32,560	69.7	6,589	14.1
Number in 1930	42,965	100.0	36,615	85.2	2,057	4.8	34,558	80.4	6,350	14.8
Actual Difference	3,739		3,500		5,498		−1,998		239	
Exp. No. in 1937[1]	46,704		39,717		2,241		37,476		6,987	
Surplus over 1930	3,739		3,102		184		2,918		637	
Net Difference	0		*598*		*1,314*		*−4,916*		*−398*	
C										
FEMALE										
Number in 1937	46,359	100.0	14,388	31.0	3,457	7.4	10,931	23.6	31,971	69.0
Number in 1930	41,840	100.0	10,206	24.4	369	0.9	9,837	23.5	31,634	75.6
Actual Difference	4,519		4,182		3,088		1,094		337	
Exp. No. in 1937[1]	46,359		11,155		400		10,755		35,204	
Surplus over 1930	4,519		949		31		918		3,570	
Net Difference	0		*3,233*		*3,057*		*176*		*−3,233*	

NOTE: Number of workers in 1937 and 1930 adjusted for differences in definitions; employed workers include those defined in 1937 as fully employed, partly employed, part-time workers, and ill or voluntarily idle; unemployed include totally unemployed and emergency workers in 1937, and unemployed of class A in 1930, adjusted for comparable definitions; "expected" number of workers in 1937 computed by adjusting 1930 workers for changes in population by age-groups and sex from April, 1930, to November, 1937. Due to the adjustments for comparable definitions, there are certain discrepancies between the figures for 1937 in this Table and in Appendix Table A.

[1] Conditions as of 1930.

SOURCE: UNITED STATES CENSUS OF PARTIAL EMPLOYMENT, UNEMPLOYMENT, AND OCCUPATIONS, 1937: Vol. IV, Chapter VIII, Table 49, p. 111; Table 69, p. 134. FIFTEENTH CENSUS OF THE UNITED STATES, 1930: POPULATION, Vol. V, Chapter 6, Table 9; UNEMPLOYMENT CENSUS, 1930, Vol. I, Tables 1 and 6.

Table 3. Comparison of number of workers by sex and functional class in the United States in 1930 and in 1937. (In thousands.)

change in "total workers available" by sex, we see that most of the increase in male job-seekers was due simply to increased population, while the increase in female job-seekers (4,182,000) is explained by changed conditions (3,233,000), rather than population changes (949,000).

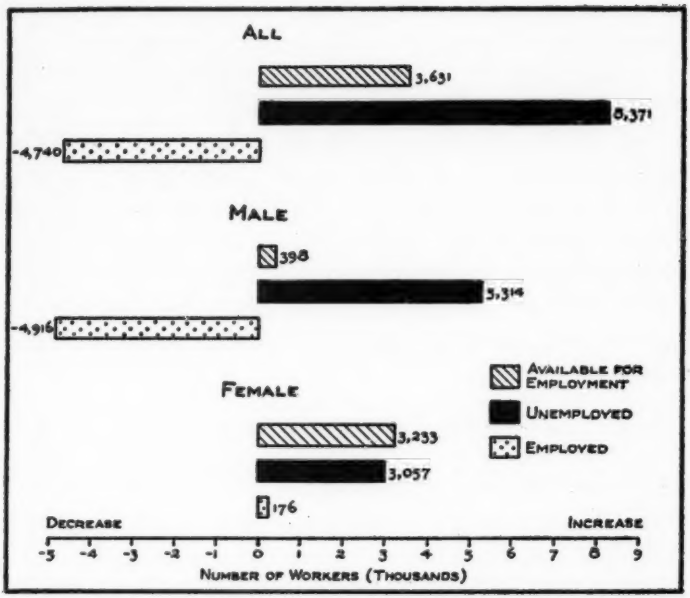

Fig. 1. Difference between actual number of workers in 1937 and number expected according to the 1930 pattern of distribution by functional class in the United States.

Table 3 also gives an answer to the second question: how much of the unemployment in 1937 was due to a decrease in the number of jobs available, and how much to an increase in the number of workers seeking jobs? The answer can be read from the three italicized horizontal rows giving the "net" differences from 1930 to 1937 in workers by various classes. Thus, we see that the net increase in the unemployed males was 5,314,000, and that it was almost entirely due to the loss of jobs, which amounted to 4,916,000. The increase of 3,057,000 in the number of unemployed women, however, was caused exclusively by the tremendous increase in job-seekers among women (3,233,000), while the number of jobs for women actually increased. Obviously, the unemployment status of the total population reflects the combined effect of both factors: the

increase of unemployment (8,586,000) is explained by a loss of 4,740,000 jobs and by an increase of 3,631,000 job-seekers.

Evidently while the depression served to increase reported unemployment it operated for each sex in an entirely different fashion. Increased male unemployment was due to loss of jobs; female unemployment was due to increase in the proportion of job-seekers. To deny, however, that the increase of unemployed women is due to the loss of jobs would not be in strict accordance with the facts. It is due to the loss of jobs—by men, not by women. Loss of jobs by primary workers with its lowering of family levels of living has sent streams of secondary workers into the labor market in search of gainful employment.

THE POPULATION PYRAMID AND THE PATTERN OF EMPLOYMENT

Secondary workers have also been drawn from our reservoir of maturing youth. This movement is made clear when the pattern of employment is studied in connection with the population pyramid (Figure 2). From 1930 to 1937 the proportion of "available" workers increased most sharply in the younger ages, 15 to 30. Thus Table 4 indicates that in the group 15-19 the proportion of males working and seeking work increased from 37.2 to 43.1 per cent; among females from 24.2 to 30.2 per cent. After age 30 the employment pattern of the sexes shows a decided differentiation. The proportion of males in the labor mar-

Table 4. Available workers as percentages of total population in each age group in 1930 and 1937.[1]

Age	Male		Female	
	1930	1937	1930	1937
15–19	37.2	43.1	24.2	30.2
20–24	85.4	90.3	41.0	53.6
25–29	95.7	97.1	30.2	42.1
30–34	97.0	97.9	23.8	34.4
35–39	97.4	97.6	22.5	31.1
40–44	97.4	96.8	21.3	28.0
45–49	97.0	96.3	20.4	25.0
50–54	95.6	95.1	19.2	22.5
55–59	92.8	91.9	17.0	18.8
60–64	86.6	84.7	14.4	15.5
65–69	75.4	67.8	11.2	10.5
70–74	57.1	45.2	7.5	5.6

[1] Adjusted to a comparable definition. "Available workers" include both job-holders and job-seekers.

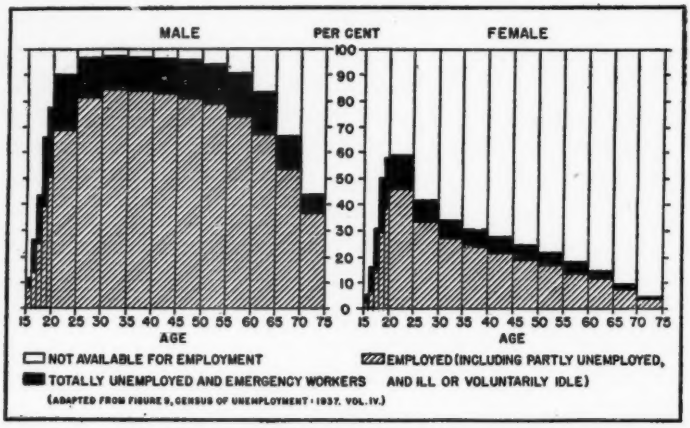

Fig. 2. Per cent distribution by functional class of the population of each age-sex group in the enumerative check areas of the Census of Unemployment, 1937. Reprinted from *Population Index*, 4, No. 4.

ket becomes stable at 30 and shows a slight decline after 40. Females however continue to flow into the labor market until after 65. The effect of old age pensions in the period may be seen in the marked decline of workers available after 65. For males 65-69 the decline was from 75.4 to 67.8 per cent.

Figure 2, which presents the population pyramid in terms of the three functional classes in 1937, shows that the conflicting claims of "unemployed" and "unavailable for employment" are especially apparent in the younger ages and among females. As women reach the age of marriage and mature home-making, their proportions in the labor market drop rapidly. Only in age group 20-24 are as many as half (53.9 per cent) of the women in the labor market. It is noticeable that by far the highest rate of unemployment (13 per cent) is found among women, 15-24 years old. Moreover when we analyzed the "net differences" in Table 3 by age groups we found that unemployment among youth 15-30 was due to an increase of job-seekers and not to a decrease of number of jobs from 1930 to 1937.

CONCLUSION

The preceding analysis clearly shows the tendency of mounting loss of jobs to increase disproportionately the numbers accounted as unemployed. When primary workers, the family bread winners, are displaced, secondary workers composed largely of women and youth enter the labor market in search of employment. Thus if the numbers displaced from jobs be counted as unity, the resulting increase in the number of unemployed will be a figure much greater than unity. Here we can make use of our estimates in order to secure a ratio. The loss of 4,740,000 jobs (1930-1937) gave a total increase of 8,586,000 unemployed. Thus if the loss of jobs be regarded as 100, the increase in the number of unemployed was 181. Some 215,000 of the additional unemployed were due, however, to natural increase in the population, 15-74. If we deduct this number, the ratio of increased unemployment to lost jobs becomes 176 per cent. This is equivalent to the statement that if 100 jobs are lost in the population, we may expect to find thereby not 100 but 176 unemployed. This, it seems, is what happened between 1930 and 1937.

To some these figures may suggest that unemployment should decline at an accelerating ratio once employment again picks up. As employment mounts, so the theory runs, the number seeking employment will decline at a greater than one to one ratio. This will be true if (1) primary workers are reemployed; and (2) if the body of secondary workers, composed largely of women, relinquish jobs or the search for jobs as primary workers are reemployed. To test this hypothesis it might be suggested that social policy should be first directed to the reemployment of the 4,916,000 males who have lost jobs since 1930. By the time this is done, it may be predicted that most of the 3,233,000 unemployed recently added to the labor market will be retired.

Such a view, some sociologists may point out, discounts the effect

of changes of habits and attitudes on women wage-earners. The effect of declining births and increasing life expectancy has been to enlarge the labor market at both ends of the life span. Women may no longer feel called upon to choose between jobs and marriage, but they may increasingly come to prefer pay envelopes to the child care that once went with marriage. Confronted with these imponderables we might find that reemployment of primary workers will not decrease so-called secondary unemployment as fast as the loss of jobs increased it during the depression. This leaves us with the disquieting thought that the numbers in the labor market are bound to increase, giving us a large reservoir of secondary unemployment. Some believe that this phenomenon is characteristic of the shift to urban environment.

These considerations impinge on public policy in the debatable question of rationing jobs by primary and secondary workers per family. Already applied to work relief, and to public employment in some states, this is a policy which traditional American individualism has hitherto largely avoided. It would be very repugnant to our traditional views, for example, to provide that joint employment of husband and wife should not be encouraged as long as families existed in which both husband and wife were unemployed and seeking work. Certainly in regard to qualifications for jobs this policy would run into great difficulties.

Some may be inclined to point out that attitudes developed in an expanding economy when more of our population was rural can hardly be maintained in a contracting economy where most of the population is urban. Here it may be claimed that the persistence of individualistic attitudes will make necessary more collective action, that is, public relief. Others may contend that an equitable application in private industry of the distinction between primary and secondary unemployed would the more quickly reduce unemployment and thus the need for public relief. There are those, no doubt, who would claim that such a policy should make for a more even

distribution of incomes, and might stimulate rising marriage and birth rates.

It should be realized by all that the effect of continued unemployment will be to make the struggle for jobs as much of a social and political issue as the question of relief itself. At this point, however, we are easily reminded that to make rabbit pie, one first catches the rabbit. Jobs for the primary unemployed are not yet in sight. If there should become apparent in our technology a long-time trend away from jobs in heavy industry for males to service jobs for women, reemployment of primary workers will become a hopeless issue, giving way to jobs for the secondary unemployed. As the skills of many primary unemployed become obsolescent, another question arises. Under such conditions is it likely that men will follow the pattern set by women workers and gradually become "unavailable for gainful employment"? Certainly the depressing effect of such trends on marriage and the birth rates should prove of the greatest importance to students of population policy.

APPENDIX

METHODOLOGY

Many doubts have been cast on the validity of the unemployment enumeration taken in connection with the regular Census of 1930. Many of these criticisms, no doubt, are justified, but it is beyond the scope of this analysis to attempt to readjust the figures by any of the criteria suggested. It is necessary, however, to make several readjustments required by differences in the definition of classes used in the two periods. These adjustments have to do with (1) unpaid family workers, (2) "new" workers, and (3) the distinction between wanting work and actively seeking it.

"Gainful workers" of the 1930 Census are persons usually working for pay or profit whether actually employed (fully or partly) or unemployed at the time of the Census. This class corresponds to the "employed or available for employment" in 1937. However, in 1930 the number of gainful workers included all those classified as "unpaid family workers,"

a category excluded in 1937 from the number of those "available for employment" and added to the "unavailables." The great majority of unpaid family workers were engaged in agriculture. Since the 1930 Census classifies these workers in agriculture by age and sex groups, it was a simple matter to exclude them from the total gainful workers and add them to the "unavailable" group for 1930. Table B shows in the first three columns the procedure of adjustment for all gainful workers expressed as percentages of the population in each age-group by sex. The group of gainful workers in 1930 was subdivided into "totally unemployed," class A, as defined in Volume I of the 1930 Census of Unemploy-

Table A. Estimated population 15 to 74 years of age by functional class and by sex with per cent distribution in the United States. 1937. (In thousands.)

	All		Male		Female	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Total Population (15–74)	*93,063*	*100.0*	*46,704*	*100.0*	*46,359*	*100.0*
Employed or Available for Employment	*54,474*	*58.5*±0.5[1]	*39,978*	*85.6*±0.4[1]	*14,496*	*31.3*±0.9[1]
Totally Unemployed	8,928	9.6±0.5	5,761	12.3±0.5	3,167	6.8±0.4
Emergency Workers	2,055	2.2±0.1	1,657	3.5±0.2	398	0.9±0.1
Partly Unemployed	5,550	6.0±0.4	4,058	8.7±0.5	1,492	3.2±0.3
Part-Time Workers	1,190	1.3	688	1.5	502	1.1
Fully Employed	36,079	38.8±0.6	27,399	58.7±0.9	8,680	18.7±0.6
Ill or Voluntarily Idle	672	0.7	415	0.9	257	0.6
Not Available for Employment	38,589	41.5±0.5	6,726	14.4±0.4	31,863	68.7±0.9

NOTE: "Employed" workers consist of several groups: the partly unemployed, part-time workers, "ill and voluntarily idle," and fully employed. A distinction in this classification is that the partly unemployed are looking for more work while part-time workers do not need more work. Unemployed are the totally unemployed and the emergency workers (W.P.A., P.W.A., C.C.C., and others). Together these classes make up the total labor force. Those not available for work comprise all outside the labor market, that is, all not actively seeking gainful employment. Among these are old persons, young persons pursuing studies, and housewives whose unpaid services are confined to the home or to helping in their husbands' businesses. Contrary to the practice of the 1930 Census, so called "unpaid family workers" are included by the 1937 Census among those unavailable for work.

[1] Limits of sampling variation are 99 per cent fiducial limits. Estimates for total population obtained from independent source and are not subject to sampling variation. Fiducial limits for "part-time" and the "ill" not computed.

SOURCE: UNITED STATES CENSUS OF PARTIAL EMPLOYMENT, UNEMPLOYMENT, AND OCCUPATIONS, 1937: Vol. IV, THE ENUMERATIVE CHECK CENSUS, Table 6, p. 20.

ment (corresponding to totally unemployed plus emergency workers of 1937), and "employed," containing the remaining groups of gainful workers and corresponding to the three categories of "employed" plus "partly unemployed" of the 1937 Census. It is obvious that the correction for "unpaid family workers" was also applied to the number of "em-

Table B. Workers available for gainful employment adjusted to a comparable definition in 1930 and 1937 as percentages of total population in each age group in the United States.

Sex and Age Group	1930			1937			
	Per Cent Gainful Workers	Per Cent Unpaid Family Workers[1]	Adjusted Per Cent Gainful Workers	Per Cent Employable Workers	Per Cent New Workers[2]	Per Cent Omitted Unemployed Workers[3]	Adjusted Per Cent Gainful Workers
	(1)	(2)	(1)−(2)	(4)	(5)	(6)	(4)−(5)+(6)
Male							
15–19	47.8	10.6	37.2	44.7	2.9	1.3	43.1
20–24	89.9	4.5	85.4	90.2	1.1	1.2	90.3
25–29	97.0	1.3	95.7	96.6	0.4	0.9	97.1
30–34	97.6	0.6	97.0	97.4	0.2	0.7	97.9
35–39	97.7	0.3	97.4	97.1	0.2	0.7	97.6
40–44	97.6	0.2	97.4	96.3	0.2	0.7	96.8
45–49	97.2	0.2	97.0	95.7	0.2	0.8	96.3
50–54	95.7	0.1	95.6	94.4	0.3	1.0	95.1
55–59	93.0	0.2	92.8	90.9	0.4	1.4	91.9
60–64	86.8	0.2	86.6	83.7	0.5	1.5	84.7
65–69	75.7	0.3	75.4	66.7	0.7	1.8	67.8
70–74	57.5	0.4	57.1	44.1	0.5	1.6	45.2
Female							
15–19	26.6	2.4	24.2	32.4	3.2	1.0	30.2
20–24	42.4	1.4	41.0	53.9	1.6	1.3	53.6
25–29	31.0	0.8	30.2	41.9	0.8	1.0	42.1
30–34	24.4	0.6	23.8	34.3	0.8	0.9	34.4
35–39	23.1	0.6	22.5	31.1	0.8	0.8	31.1
40–44	21.9	0.6	21.3	27.9	0.7	0.8	28.0
45–49	21.0	0.6	20.4	24.9	0.7	0.8	25.0
50–54	19.7	0.5	19.2	22.4	0.6	0.7	22.5
55–59	17.3	0.3	17.0	18.7	0.6	0.7	18.8
60–64	14.7	0.3	14.4	15.3	0.4	0.6	15.5
65–69	11.4	0.2	11.2	10.2	0.2	0.5	10.5
70–74	7.6	0.1	7.5	5.5	0.1	0.2	5.6

[1] Contrary to the practice of the 1930 Census, unpaid family workers were included by the 1937 Census among those unavailable for work rather than among the gainful workers.
[2] New workers were those who never worked before but were actively seeking work.
[3] Unemployed workers who were omitted from the total employable workers are those who wanted work but did not actively seek it.

SOURCE: UNITED STATES CENSUS OF PARTIAL EMPLOYMENT, UNEMPLOYMENT, AND OCCUPATIONS, 1937: Vol. IV, Chapter VIII, Table 49, p. 111.

ployed" in 1930 but left the number of "unemployed" unchanged, since it does not affect this class of workers.

Two corrections were applied to the figures of 1937. The category of "new workers," persons seeking jobs who had never worked before, was excluded from the 1937 figures for "workers available for employment" to correspond with the 1930 practice. This adjustment is shown in column 5 of Table B. The second correction of the 1937 employable workers was required because of the definition of a certain group of unemployed. In 1930 all persons usually working, but without jobs and wanting work were classified as totally unemployed (Class A). In 1937 the enumerators were instructed to register as unemployed only those who were actively seeking jobs. This small group of totally unemployed, wanting work but not actively seeking it, were added to the 1937 figures in order to make them comparable to 1930 (columns 6, 7, Table B). Within the group of total available workers these corrections were applied to the totally unemployed, while the group of employed in 1937 was left unchanged since both corrections do not refer to employed workers.

The method of readjustment and the difficulties caused by variation in definition are fully discussed in Volume IV of the Unemployment Census (pp. 110-113). Obviously, many refinements of adjustment might be attempted, such as correction for unpaid family workers in industries. A number of such adjustments on the basis of fragmentary census data at hand were tried out by the Census. It was found that many of them worked in opposite directions, leaving the final results without significant change.

SALIENT POINTS OF ATTACK AGAINST TUBERCULOSIS[1]

JEAN DOWNES[2]

PUBLIC health procedures in the control of tuberculosis are today based upon our knowledge of the etiology and the epidemiology of the disease. Koch's discovery of the tubercle bacillus with his subsequent evidence of the infectious nature of the disease provided a foundation for further study and research. Knowledge of the disease has increased tremendously; however, there is as yet no simple cure for tuberculosis and no definite means of effective immunization against the disease. Briefly, the program for the control of tuberculosis is now based upon the prevention of the acquisition of infection and upon curative treatment for those with manifest disease.

During the past few years, epidemiological research in tuberculosis has extended our knowledge along two lines, both of which are exceedingly important if the program of control is to become more direct and specific. These are: (1) the ages at which the risk of disease and the risk of death is greatest; and (2) identification of the population group which has the greatest hazard from exposure to tuberculous infection. The purpose of this paper is to review some of this newer knowledge gained through special studies and to emphasize again the salient points of attack in the control of tuberculosis.

THE AGE CURVE OF DISEASE AND DEATH

Discovering the case of active pulmonary tuberculosis is funda-

[1] This paper was read as the annual lecture on tuberculosis for the Minneapolis Nurses' Association and sponsored by the Hennepin County Tuberculosis Association. Minor revisions have been made for publication.

[2] From the Milbank Memorial Fund.

Acknowledgment is made to Dr. Kenneth F. Maxcy of The Johns Hopkins School of Hygiene who gave helpful suggestions and criticisms concerning the presentation of the data in this paper.

Age Groups	Rate Per 10,000 Population		Number of Cases of Active Tuberculosis		Population	
	Male	Female	Male	Female	Male	Female
All Ages	8.0	9.1	322	349	36,338	35,004
0–4	2.1	0.8	8	3	3,431	3,274
5–9	1.5	2.1	6	8	3,539	3,414
10–14	1.6	2.1	6	8	3,420	3,441
15–19	8.0	14.5	27	49	3,061	3,066
20–29	13.5	19.1	79	108	5,325	5,136
30–39	10.8	12.2	62	68	5,232	5,070
40–49	11.5	9.6	57	45	4,493	4,274
50–59	9.1	8.2	36	30	3,594	3,342
60–69	8.7	8.3	25	22	2,605	2,420
70+	8.9	4.6	16	8	1,638	1,567

Table 1. Average annual incidence of active cases of tuberculosis (all forms) by age groups and sex, Cattaraugus County, 1923-1933.

mental in the program of control. Our efforts in case-finding were in the past directed largely toward the easiest population group to reach, namely, the children. However, during recent years the search for tuberculosis has been definitely shifted from the grade school age child and is now centered mainly upon adolescents and and young adults. This change in emphasis has been brought about by recognition of the fact that the incidence of active clinical disease is lower among individuals of grade school age than at any other age period.

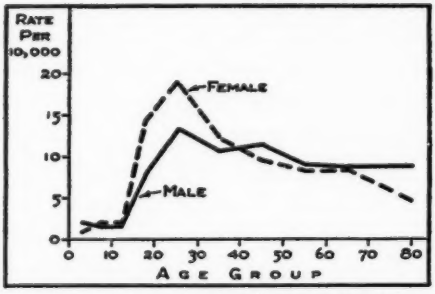

Fig. 1. Average annual incidence of active cases of tuberculosis (all forms) at specific ages for each sex, Cattaraugus County, 1923-1933.

Age Incidence of Active Tuberculosis. A study of the age incidence of tuberculosis in Cattaraugus County, New York, during the eleven-year period 1923-1933, indicated that for both males and females in the com-

munity as a whole, active tuberculosis occurred most frequently in early adult life.[3] These data are shown in Table 1 and Figure 1. The incidence of cases of active disease was relatively low for males and females under 15 years of age, where the rates for each sex were approximately 2 per 10,000 population. The age curve for each sex showed a rapid increase after age 15 and the peak of incidence was reached in early adult life; namely, at ages 20-29, where the rate for males was slightly less than 15 per 10,000 and that for females reached 20 per 10,000 population. The significant fact brought out by Figure 1 is that the risk of developing active tuberculosis is greatly increased during early adult life.

Table 2. Age incidence of secondary cases of active tuberculosis in eighty-three tuberculous families in Cattaraugus County.

Age Groups	Rate per 100 Years of Life	Number of Secondary Cases of Active Tuberculosis	Number of Years of Life Observed At Each Age
0- 4	3.6	5	137
5- 9	0	0	304
10-14	1.3	4	309
15-19	2.0	6	301
20-29	2.7	12	441
30-39	0.4	1	279
40-49	0	0	279
50-59	0	0	234
60+	0	0	189

The age incidence of secondary cases among contacts in tuberculous families in Cattaraugus County is shown in Table 2 and Figure 2.[4] At ages 0-4 the incidence was 3.6 per 100 persons per year, the highest noted in any age group. At ages 5-9 the rate was zero, at ages 10-14 the incidence of cases was 1.3 per 100 persons per year. The frequency of cases in the next age period increased rapidly and reached a second peak at ages 20-29, where the rate was 2.7 per 100 persons per year. Tuberculosis mortality and morbidity in the general population indicate a definite age selection. Of special interest is the fact that the age selectivity of the disease is striking, even

[3] Downes, Jean: The Age Incidence of Tuberculosis and Its Significance for the Administrator. The Milbank Memorial Fund *Quarterly*, April, 1935, xiii, No. 2, pp. 152-161.

[4] Downes, Jean: A Study of the Risk of Attack Among Contacts in Tuberculous Families in a Rural Area. *The American Journal of Hygiene*, November, 1935, xxii, No. 3, pp. 731-742.

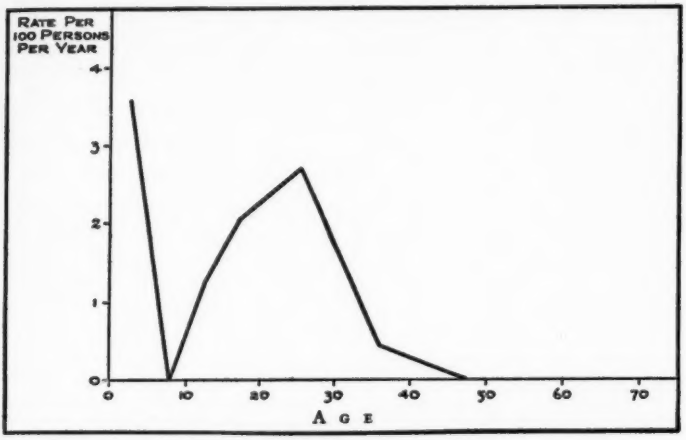

Fig. 2. Age incidence of secondary cases of active tuberculosis among family contacts in eighty-three tuberculous families in Cattaraugus County.

when the factor of exposure is held relatively constant, as in the experience of the tuberculous families.

Age Curve of Mortality. In the Original Registration Area of the United States the mortality from tuberculosis has declined 68 per cent since 1910. It is most gratifying to know that the death rate today is less than one-third the rate of thirty years ago. Individuals throughout the span of life have participated in this decline. This is plainly evident from the data in Table 3 and Figure 3, which portray the tuberculosis mortality at specific ages in the Original Registration States for the period 1908-1912 contrasted with the mortality in the same area in the years 1934-1936. Excluding the differences in level, the two mortality curves are generally similar in shape except that in the more recent period 1934-1936 the mortality reached its peak in the older ages, 55 and over; and in the earlier period the highest mortality was recorded at ages 30-49.

These changes in the shape of the age curve of mortality may be more clearly demonstrated by eliminating the effect of the differences in the level of the two curves. This may be done by plotting

Age Groups	Mean Rate Per 100,000 Population		Ratio of the Rate at Each Age to the Rate for All Ages	
	1908–1912[1]	1934–1936[2]	1908–1912	1934–1936
All Ages	160.2	51.2	1.00	1.00
0– 4	128.9	19.5	.80	.38
5– 9	30.5	5.7	.19	.11
10–19	77.6	17.6	.48	.34
20–29	203.1	62.2	1.27	1.21
30–39	232.4	66.0	1.45	1.29
40–49	210.7	69.7	1.32	1.36
50–59	189.0	75.6	1.18	1.48
60–69	189.7	80.3	1.18	1.57
70+	180.3	80.9	1.13	1.58

[1] Data obtained from Mortality Statistics, Bureau of the Census. Rates are based upon the population of 1910.
[2] Data obtained from Mortality Statistics, Bureau of the Census. Population of 1935 was obtained by applying the percentage distribution by age, estimated for each state by the Scripps Foundation, to the total estimated population of 1935 for the ten Original Registration States.

Table 3. Mortality by age from tuberculosis (all forms) and ratio of rates at specific ages to the total rate in the Original Registration Area in 1908-1912 and in 1934-1936.

for each time period the age specific rates as ratios to the average rate for all ages. Figure 4 and Table 3 which show the relative mortality from tuberculosis at specific ages, indicate that in the more recent period the mortality from tuberculosis among persons over fifty years of age has increased compared with the mortality among persons at those ages some twenty-five years ago. In old age the rate is now 58 per cent above the average for all ages contrasted with an excess of 10 to 18 per cent at the older ages in the earlier period. For persons under thirty years

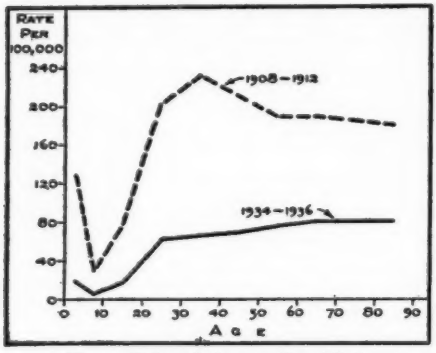

Fig. 3. Tuberculosis mortality (all forms) by age in the Original Registration States in 1908-1912, compared with 1934-1936.

of age, the age curve has undergone no such marked change in shape.

Figure 5 illustrates the fact that this increase in the relative mortality in the old-age period is common to both sexes, males and females. The rates upon which the ratios are based are shown in Table 4. Even though these data are based on an eastern section of the United States, the same phenomenon is occurring in other areas. For example, Figure 6 shows the relative mortality by age from tuberculosis for the City of Minneapolis during the five-year period 1900-1904 contrasted with the more recent period 1929-1931. Here again, the death rate among old people shows in more recent times a marked excess over the average rate for all ages when contrasted with a period some thirty years earlier.

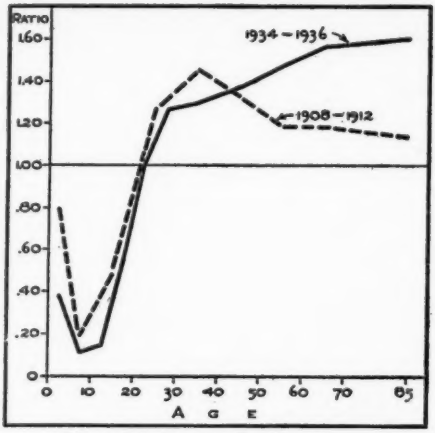

Fig. 4. Relative mortality from tuberculosis (all forms) by age in the Original Registration States in 1908-1912, compared with 1934-1936.

A most significant contribution to our knowledge of the epidemiology of tuberculosis was made by the late Dr. Wade H. Frost in a paper dealing with the age selection of mortality from tuberculosis in successive decades which has just been published in *The American Journal of Hygiene*.[5] Dr. Frost said:

> As we pass along the age scale from infancy through childhood, to early adult life, and on to old age, the curve of mortality from tubercu-

[5] Frost, Wade Hampton: The Age Selection of Mortality from Tuberculosis in Successive Decades. *The American Journal of Hygiene*, November, 1939, 30, No. 3, Sec. A., pp. 91-96. Reprinted in the Milbank Memorial Fund *Quarterly*, January, 1940, xviii, No. 1, pp. 61-66.

losis shows a continuous movement either upward or downward. This is such a familiar fact that we are apt to take it for granted; to dismiss it as characteristic of the disease, and to pass on. But there is perhaps no single statistical fact which is potentially of more significance. For every change in the rate of mortality as we pass from one age to another represents a shift in the balance established between the destructive forces of the invading tubercle bacillus, and the sum total of host-resistance.

Dr. Frost pointed out that this shift in the risk of mortality to the older ages is more apparent than real. He has shown that in successive cohorts since 1870 the age selection has been uniform. Figure 7, which is a reproduction of a chart from Dr. Frost's paper, shows the age specific mortality from tuberculosis throughout the life of male cohorts of the decades 1880, 1890, 1900, and 1910 in the State of Massachusetts. A cohort includes the life experience of individuals born within a given period of time. For example, male persons born during the period 1871-1880 form the cohort of 1880, and in that year they were 0-9 years of age; in 1890 this cohort had reached ages 10-19. Members of this cohort who survived to 1930 were at that time 50 to 59 years of age. The figure shows the tuberculosis mortality at successive ages up to the year 1930 for each group of male cohorts. Dr. Frost, in discussing this

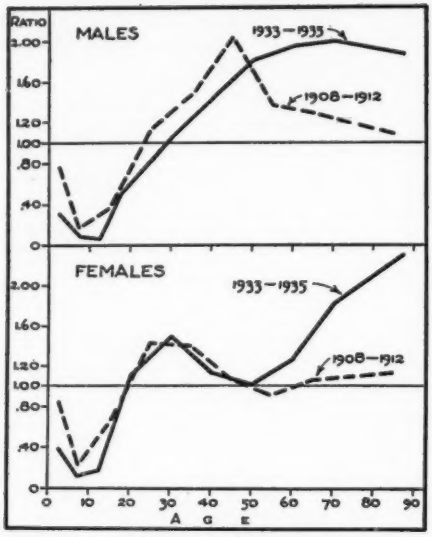

Fig. 5. Relative mortality from tuberculosis (all forms) by age for males and females in the Original Registration States in 1908-1912, compared with 1933-1935.

Age Groups	Mean Rate Per 100,000 Population		Ratio of the Rate at Each Age to the Rate at All Ages	
	Males	Females	Males	Females
	ORIGINAL REGISTRATION AREA—1908–1912			
All Ages	179.2	140.8	1.00	1.00
0– 4	138.0	119.5	.77	.84
5– 9	29.4	31.6	.16	.22
10–19	65.7	89.4	.37	.63
20–29	204.6	201.6	1.14	1.43
30–39	266.4	196.5	1.49	1.40
40–49	367.5	150.3	2.05	1.07
50–59	245.9	129.0	1.37	.92
60–69	231.2	149.2	1.29	1.06
70 and Over	198.5	164.2	1.11	1.17
	1920 REGISTRATION AREA—1933–1935			
All Ages	52.9	38.7	1.00	1.00
0– 4	16.9	15.4	.32	.40
5– 9	5.1	4.4	.10	.11
10–14	4.1	6.4	.08	.17
15–24	26.1	42.8	.49	1.10
25–34	55.9	58.2	1.06	1.50
35–44	77.2	43.8	1.46	1.13
45–54	96.9	39.4	1.83	1.02
55–64	104.3	48.9	1.97	1.26
65–74	106.9	70.6	2.02	1.82
75 and Over	100.4	89.8	1.90	2.32

Table 4. Mortality by age from tuberculosis (all forms) among males and females and ratio of rates at specific ages to the total rate in the Original Registration Area 1908-1912 and in the 1920 Registration Area—1933-1935.

chart, pointed out the highly significant fact that the "terminal" rates for these cohorts constitute the 1930 age curve of mortality. The cross-hatched section in the lower part of the chart indicates the mortality at specific ages in the year 1930.

The 1930 curve considered alone gives the impression that at the present time an individual encounters his greatest risk of death from tuberculosis between the ages of 50 and 59. But Dr. Frost pointed out that this is not really so; the people making up the 1930 age group 50-59 have, in earlier life, passed through greater

mortality risks—(note the mortality at ages 0-4 and 20-29 for the cohort of 1880). Dr. Frost directed special attention to the fact that in successive cohorts the age selection has been uniform, with the mortality highest in the first five years of life, and again from 20-29 years of age; thereafter the mortality declines. This study has thrown a new light upon the age curve of mortality from tuberculosis.

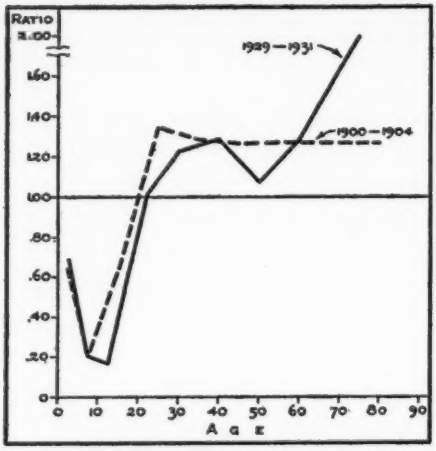

Fig. 6. Relative mortality from tuberculosis (all forms) by age in Minneapolis, Minnesota, in 1900-1904, compared with 1929-1931.

It seems suitable at this point to refer to a study based upon the experience of tuberculous families in Cattaraugus County, New York. Figure 8 and Table 5 show the mortality from all causes at specific ages among offspring of a tuberculous parent compared with the mortality in a sample population.* The population considered in this study included individuals born during the period 1850 to 1900 who survived to age one. Though these data are not strictly comparable with the cohort experience presented by Dr. Frost, in that they do not represent individuals born within a single decade, nevertheless they do represent the life experience of individuals born within a given period of time. Tuberculosis deaths constituted a high proportion of the deaths from all causes among the offspring of a tuberculous parent and it is quite evident from Figure 8 that the age curve of death among these individuals was strikingly

*Downes, Jean: The Risk of Mortality Among Offspring of Tuberculous Parents in a Rural Area in the Nineteenth Century. *The American Journal of Hygiene*, November, 1937, xxvi, No. 3, pp. 557-569.

similar *in shape* to that among the cohorts shown in the preceding figure (Figure 7). The mortality was highest among young adults aged 20-29.

These findings have the highest significance to those engaged in the work of combating tuberculosis, for they indicate the ages which should be emphasized. They furnish incontrovertible evidence that after the interval of infancy the period of maximum risk of mortality from the disease, both in the general population and in tuberculous families, has been, and still is, during early adult life. Furthermore, the period of greatest risk of developing clinical tuberculosis is similar to the age period where the risk of death from the disease is greatest. This fact was shown by the studies of age inci-

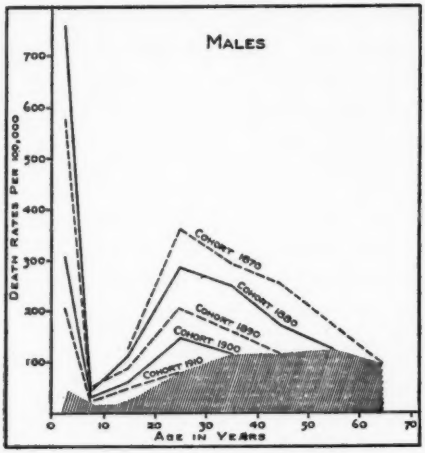

Fig. 7. Tuberculosis mortality (all forms) by age in successive ten-year cohorts (males) in Massachusetts, 1870-1910.

Data from Frost, Wade H.: The Age Selection of Mortality from Tuberculosis in Successive Decades. *The American Journal of Hygiene,* November, 1939. (The cross-hatched section, showing the 1930 age curve of mortality, has been added to the original chart.)

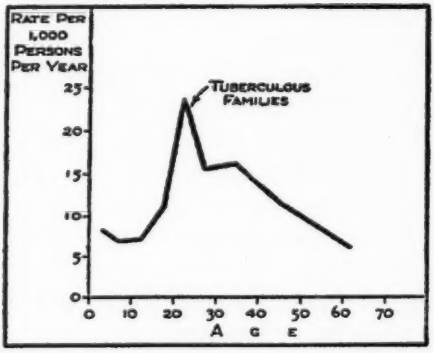

Fig. 8. Mortality from all causes by age among offspring in tuberculous families, Cattaraugus County, 1850-1900.

dence of the disease in the general community and among contacts in tuberculous families in Cattaraugus County, and referred to earlier.

Another implication of the data dealing with cohorts, pointed out by Dr. Frost, is that "if the frequency and extent of exposure to infection in early life has decreased progressively decade by decade, there is no indication that this has had the effect of exaggerating the risk of death in adult life due to lack of opportunity to acquire specific immunity in childhood." This conclusion of Dr. Frost's should give us greater confidence in the wisdom of advocating the protection of the public against the acquisition of even small amounts of tuberculous infection.

Table 5. Mortality from all causes in a population composed of persons born previous to 1901, Cattaraugus County.[1]

Age Groups	Mortality From All Causes (Rate per 1,000 Population)	Number of Deaths All Causes	Years of Life
All Ages	7.9	1,514	190,945
1- 4	13.0	207	15,970
5- 9	4.0	78	19,400
10-14	3.0	58	19,057
15-19	4.1	76	18,753
20-24	6.0	110	18,262
25-29	5.8	103	17,704
30-34	5.2	89	16,985
35-39	5.1	79	15,393
40-49	6.7	166	24,898
50+	22.3	548	24,523

[1] The population includes the 4,121 individuals who survived to age one in 1,062 families.

Dr. Frost concludes also that "constancy of age selection (relative mortality at successive ages) in successive cohorts suggests rather constant physiological changes in resistance (with age) as the controlling factor." This is a highly significant conclusion.

In a study of the risk of mortality among white and colored tuberculin-positive infants, Brailey has shown that even among children under two years of age, resistance to mortality is affected by the age at which tuberculous infection is discovered.[7] Children found to be infected before six months of age had a mortality of 33 per cent within the first year of observation, and the mortality

[7] Brailey, Miriam: Mortality in Tuberculin-Positive Infants. *Bulletin of the Johns Hopkins Hospital*, July, 1936, lix, No. 1, pp. 1-10.

was nearly 78 per cent within the five years following the discovery of infection. For children for whom tuberculous infection was demonstrated after six months and up to two years of age, the mortality was only 16 per cent in the five years subsequent to the discovery of infection. Brailey points out that these differences in mortality are significant.

Recently interest has been centered upon efforts to learn the cause of the definite increase in mortality from tuberculosis at certain ages, especially among females of the teen ages. Finding no definite factor to which the increase in mortality with age could be assigned, it has been generally assumed that the increase is due to biological factors. Certainly the data taken from Dr. Frost's paper offer the most convincing evidence, even though he ventures to call it only suggestive, presented so far, that physiological changes in resistance (with age) is the controlling factor in relative mortality from tuberculosis at different ages. No one has attempted to explain exactly what these physiological changes in resistance may be, which upset the balance maintained by the host against the tubercle bacillus, or how they operate. Even though the physiological factors themselves and their operation causing changes in human resistance are not known, nevertheless, attention should now be centered upon the study of ways and means of increasing general or nonspecific resistance to tuberculosis at the particular ages where it seems to be lowest, as evidenced by the greatest occurrence of morbidity and mortality from the disease.

It should be added that the results of efforts to increase specific resistance to tuberculosis by vaccination with an attenuated form of the bovine type of tubercle or with the heat-killed human bacillus are not sufficiently well established, both as to the harmlessness of vaccination and as to its protective value, to justify its general use as a public health measure for the control of tuberculosis. Consequently, our efforts should be directed upon experimentation and study of how to increase nonspecific resistance to the disease.

THE POPULATION GROUP AT GREATEST RISK OF TUBERCULOSIS

One of the significant contributions of epidemiological research in tuberculosis has been to define in precise terms the importance of the family or household contact in the spread of the disease. Studies of the risk of attack for family contacts have been made in various areas of the United States, both urban and rural; namely, Cattaraugus County, New York; Williamson County, Tennessee; Philadelphia; the Mulberry area of New York City, and to these may be added the experience of the Lymanhurst Health Center in Minneapolis.[4, 8, 9, 10] These studies are all based upon relatively small samples of tuberculous families but there is such a high measure of agreement in the results of all of them that it is now possible to define with some assurance the extent of the hazard for persons in close familial contact with tuberculosis. The annual tuberculosis attack rates among family contacts are shown for each of the five areas in Table 6. The data drawn from the Lymanhurst experience in Minneapolis differ somewhat from the data from the other areas in that they include only individuals under twenty years of age at the beginning of the period of observation and the period of observation is considerably longer; however, they do include individuals exposed to infectious tuberculosis, and the period of observation (from 0-17 years) is sufficiently long to carry most of them well into early adult life. Consequently, it seems entirely proper to include these data.

The Philadelphia study includes the incidence of manifest tuberculosis among family contacts during the ten years following

[8] Stewart, H. C.; Gass, R. S.; Gauld, R. L.; and Puffer, Ruth R.: Tuberculosis Studies in Tennessee—Infection, Morbidity and Mortality in the Families of the Tuberculous. *The American Journal of Hygiene*, November, 1937, xxvi, No. 3.

[9] Opie, E. L.; McPhedran, F. M.; and Putnam, P.: The Fate of Persons in Contact with Tuberculosis: The Exogenous Infection of Children and Adults. *The American Journal of Hygiene*, November, 1935, xxii, No. 3.

[10] Chiu, P. T. Y.; Myers, J. A.; and Stewart, C. A.: The Fate of Children with Primary Tuberculosis. *The Journal of the American Medical Association*, April 8, 1939, 112, No. 14, pp. 1306-1307.

Areas	Rate Per 100 Years of Life	Number of Cases	Years of Life
Philadelphia 0–10 Years Observation	1.08	99	9,155
Cattaraugus County 0–10 Years Observation	1.19	27	2,264
Williamson County, Tennessee 0–10 Years Observation	1.03	20	1,934
Mulberry Area, New York City 0–9 Years Observation	1.20	23	1,859
Lymanhurst Health Center, Minneapolis 0–17 Years Observation	1.33	67	5,024

Table 6. Annual tuberculosis attack rates among family contacts in five different areas of the United States.

onset of the first sputum positive case known to have occurred in the family. In the Cattaraugus County, Williamson County, and Mulberry area studies the experience of the family contacts was confined to the period following onset of the index case, which was the case which brought the family into the special study. The Lymanhurst study includes the experience of contact children after they came under the supervision of the Lymanhurst Health Center. Even though there are some differences in the technique of these studies, nevertheless they can be compared with respect to the general results.

The annual attack rates shown in Table 6 are fairly similar in all five areas; clinical tuberculosis occurred at the rate of slightly more than one case per one hundred years of life per year among those at special risk. In a broad sense these studies have the quality of laboratory experiments. The data are drawn from various parts of the country, and one experiment tends to confirm the other. When there is such a high degree of consistency in the results, it is a justifiable conclusion that an important fact concerning the epidemiology of tuberculosis has been established.

Though the risk of developing manifest tuberculosis is similar for family contacts in various parts of the country, this special risk compared with the general hazard in the given community will depend upon the relative amount of tuberculosis in the community. The studies in which it has been possible to compare the risk of attack in the general community with that among family contacts have shown that in tuberculous families the hazard is from ten to fifteen times as great as for persons in the general population. Without question the tuberculous family is the most important group for case-finding. It must be remembered, however, that the search for cases in tuberculous families should be carried on over a period of years, for tuberculosis, unlike the acute communicable diseases, is a disease which may have a relatively long incubation period before it manifests itself in illness. Furthermore, the data presented in the first part of this paper indicate that the risk of disease and of death from tuberculosis changes with age. It may be concluded that individuals who have been exposed to infectious tuberculosis in the family should have the benefit of public health supervision during infancy, during late adolescence, and through early adult life.

In the preceding discussion attention was called to the fact that various studies have shown that the risk of tuberculosis among family contacts is from ten to fifteen times greater than is the risk for the general population. The difference in the level of tuberculosis mortality today, contrasted with the level of mortality thirty years ago, is unquestionable evidence that the risk of death, and probably also of tuberculous disease, is considerably less in the general community today than it was formerly. But there is no convincing evidence available that there has been over a period of time any marked change in the hazard of tuberculosis among family contacts. In fact, what evidence there is indicates that there has been no change.[6, 11] Too often the damage has been done; that is, tuberculous infection has been spread in the family before medical su-

[11] Weinberg, W.: DIE KINDER DER TUBERKULÖSEN. Leipzig, Verlag von S. Hirzel, 1913.

pervision or public health nursing supervision has been made available to the family. As the risk of disease and mortality from tuberculosis in the general community declines, the problem of tuberculosis is more and more concentrated in the immediate environment of the positive sputum case. Therefore a way must now be found to make public health work in tuberculous families more effective so that the hazard from tuberculosis in this population group will be greatly reduced.

THE PROGRAM FOR CONTROL OF TUBERCULOSIS

These recent advances in knowledge of the epidemiology of tuberculosis point the way to a more direct and specific program for the control of the disease. The principal kinds of activity to be included in an effective program have been most ably outlined by Dr. Frost.[13] They are as follows:

1. The isolation in sanatoria of all known open cases of pulmonary tuberculosis, continuing isolation so long as the cases remain open.
2. Adequate medical care, preferably in institutions, for the known cases of tuberculosis which are active but not in an open stage, since these cases constitute the group most likely in the immediate future to become infectious.
3. More vigorous effort to find cases of tuberculosis earlier and to bring them more promptly under medical care and under isolation if they are discharging bacilli.
4. Special protection, including medical observation and advice, and financial aid as needed, for those groups who, though not at the time suffering from tuberculosis, are most imminently endangered.

It is important to note the emphasis which Frost laid particularly upon *isolation* of the infectious case and prompt and adequate medical care for those in need of it. This measure (isolation) forms a part of three of the four activities he advocated. And it alone, if it

[13] Frost, W. H.: How Much Control of Tuberculosis? *The American Journal of Public Health*, August, 1937, 27, No. 8, p. 759.

were possible to be put into effect universally, would certainly accelerate the eradication of tuberculosis.

In the meantime, the program of tuberculosis control ought to include social measures. If the relatively high incidence of disease and death at certain ages is due to physiological changes in resistance (with age), a serious attempt should now be made to find out what definite measures will enable those most endangered to maintain the highest possible state of bodily health. This may mean that the standard of living of the tuberculous family must be given special consideration. Study and experimentation, in order to ascertain what specific measures and what sort of teaching are necessary to raise the level of resistance to this particular disease, are of immediate importance.

THE AGE SELECTION OF MORTALITY FROM TUBERCULOSIS IN SUCCESSIVE DECADES[1]

WADE HAMPTON FROST[2, 3]

AS we pass along the age scale from infancy through childhood, to early adult life, and on to old age, the curve of mortality from tuberculosis shows a continuous movement either upward or downward. This is such a familiar fact that we are apt to take it for granted; to dismiss it as characteristic of the disease, and to pass on. But there is perhaps no single statistical

[1] From the Department of Epidemiology, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Maryland.

Reprinted from *The American Journal of Hygiene*, November, 1939, 30, No. 3, Sec. A., pp. 91-96.

[2] This material was assembled by Dr. Frost in 1936 and presented before the Southern Branch of the American Public Health Association. At the time of his death in 1938, it remained unpublished. Because of fundamental implications in regard to the interpretation of age specific mortality rates and particularly in regard to the reaction of the human host to tuberculous infection, his notes are herewith made available, together with the table showing the basic data used in the report.

[3] The following quotation from a letter dated July 29, 1935, to the late Dr. Edgar Sydenstricker from Dr. Frost, is self-explanatory and is reproduced here as a document of scientific as well as historical interest.

". . . Using the Massachusetts data which you so kindly sent me, extended by the calculation of corresponding rates for 1920 and 1930, I have made up the two enclosed tables which have interested me and may be of interest to you.

"In table 1 the striking fact other than the consistent decline in mortality at every age is the progressive advancement to higher and higher ages of the peak of mortality; in 1880 the peak (or more properly the first peak) in adult life is at age 20-29, whereas, in 1930 it is in the age group 50-59. The same kind of change is, as you know, quite generally shown in other areas.

"For some years I have thought of the high mortality in later life as being related to *escape* from excessive mortality in earlier adult life. I have been thinking of the tuberculosis of today as a disease which has not the killing power to cause much mortality in the vigor of young adult life but becomes fatal in middle age or later when vital resistance has declined. It has seemed to me that it was approaching the age-selection of pneumonia—fatal chiefly at the extremes of life, non-fatal in the more vigorous ages.

"In table 2 I have set up the mortality rates in a different way, in order to show, through successive ages, the mortality of the 'cohorts' of persons who were aged 0-9 years in 1880, 1890, 1900, etc. Thus, persons aged 0-9 in 1880 would be aged 10-19 in 1890, 20-29 in 1900 and so on until in 1930 they would be in the age group 50-59. With this rearrangement table 2 shows what should have been but was not obvious to me from table 1, namely, that in each *cohort*, followed through in this way, the highest mortality has been at the age 20-29. This is perhaps more readily seen from the rough pencil graph which is enclosed.

(Continued on page 62)

record which is potentially of more significance. For every change in the rate of mortality as we pass from one age to another represents a shift in the balance established between the destructive forces of the invading tubercle bacillus, and the sum total of host-resistance. If we could accurately interpret this record, analyzing in detail each movement upward or downward and assigning to each factor its due share in the change, then we would be well on the way to knowing the epidemiology of tuberculosis.

But the record is peculiarly difficult to read with understanding, because it is immediately apparent that the most striking changes in mortality rate do not correspond to reasonably probable changes of like extent in rate of *exposure* to infection. For instance, nothing that we know of the habits of mankind and the distribution of the tubercle bacillus would lead us to suppose that between the first and the second five years of life there is, in general, a ***diminution*** in exposure to infection which corresponds to the decline in mortality rate. And there is little, if any, better reason to suppose that the extraordinary rise in mortality from age 10 to age 20, 25, or 30 is paralleled by a corresponding increase in rate of exposure to specific infection.

We are forced, then, to recognize, as at least highly probable, that

"Viewed in this light the relatively high mortality rates now exhibited in the higher age groups seem to me to have a significance quite different from what I had attributed to them. They may be interpreted as the residuum of the much higher rates which the now aged cohorts have experienced in earlier life. In general, the rule seems to be that the higher the mortality of any cohort in early life, the higher will it be in later years. Or, to have passed through a period of high mortality risk confers not protection, but added hazard in late life.

"The only other data which I have been able to study so far are for England and Wales, 1850-1930, and for the U. S. Registration Area of 1900, for the years 1900-1930. They show substantially the same relations as the Massachusetts data; also, the records for females show much the same thing, but with a more pronounced peak at the earlier age. I want to get together material for a somewhat more orderly study later.

"All of this seems to me to have a bearing on the question which is raised in the MS I sent you a few days ago—namely, how much if any we may expect adult mortality to be increased as the result of diminished infection in the favorable years of childhood—from age 3 to 12. It also seems to me to have a bearing on the moot question whether the tuberculosis of adult life is almost wholly exogenous—due to recently acquired infection—or to a considerable extent endogenous—the outcropping to clinical severity of infection which has remained latent or smoldering through the childhood years when vital resistance seems to be at its height. . . ."

the predominant factor in the up-and-down movement of mortality along the age scale is change in human resistance. And this is a complex of which we have very little exact knowledge except the plain fact that age and prior exposure bring no such immunity against tuberculosis as they establish against many of the acute infections.

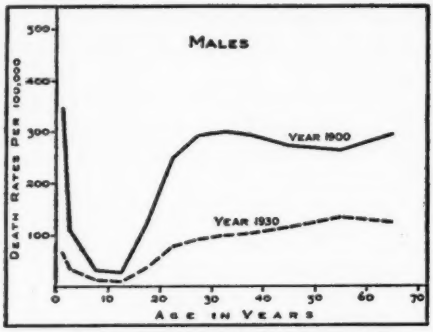

Fig. 1. U. S. Registration Area of 1900 death rates from tuberculosis—all forms—by age, 1900 and 1930.

However my purpose is not to attempt an interpretation of the age selection of tuberculosis; it is merely to call attention to the apparent change in age selection which has taken place gradually during the last thirty to sixty years, and to note that when looked at from a different point of view this change in age selection is found to be more apparent than real. The age specific curve of mortality from tuberculosis for males in the United States Registration Area of 1900 is shown for the years 1900 and 1930 in Figure 1 and for Massachusetts males for the years 1880, 1910, and 1930 in Figure 2.

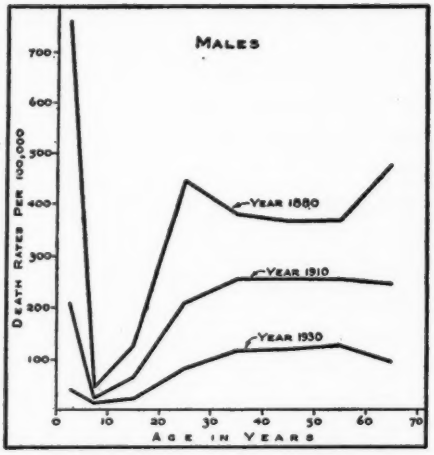

Fig. 2. Massachusetts death rates from tuberculosis—all forms—by age, 1880, 1910, 1930.

The tuberculosis mortality rates for Massachusetts used throughout this paper are shown in Table 1. You will note that:

1. At every age mortality is lower in the later period.

2. In each period age selection is generally similar: mortality is high in infancy; declining in childhood; rising in adolescence to a higher level in adult life.

3. In the later period (1930) the highest rate of mortality comes at the age of 50 to 60, whereas formerly it was at age 20 to 40.

These characteristic changes from decade to decade can be demonstrated in the records for many different areas, both for males and females.

Looking at the 1930 curve, the impression given is that nowadays an individual encounters his greatest risk of death from tuberculosis between the ages of 50 and 60. But this is not really so; the people making up the 1930 age group 50 to 60 have, in earlier life, passed through *greater* mortality risks.

Table. 1. Death rates[1] per 100,000 from tuberculosis, all forms, for Massachusetts, 1880 to 1930, by age and sex, with rates for cohort of 1880 indicated.

Age	1880	1890	1900	1910	1920	1930
MALES						
0– 4	760	578	309	209	108	41
5– 9	43	49	31	21	24	11
10–19	126	115	90	63	49	21
20–29	444	361	288	207	149	81
30–39	378	368	296	253	164	115
40–49	364	336	253	253	175	118
50–59	366	325	267	252	171	127
60–69	475	346	304	246	172	95
70+	672	396	343	163	127	95
FEMALES						
0– 4	658	595	354	162	101	27
5– 9	71	82	49	45	24	13
10–19	265	213	145	92	78	37
20–29	537	393	290	207	167	92
30–39	422	372	260	189	135	73
40–49	307	307	211	153	108	53
50–59	334	234	173	130	83	47
60–69	434	295	172	118	83	56
70+	584	375	296	126	68	40

[1] They were obtained as follows: For the years 1910, 1920, and 1930—based on U. S. Mortality Statistics—deaths from tuberculosis, all forms. For the years 1880, 1890, and 1900 the rates used are calculated from data compiled by the late Dr. Edgar Sydenstricker from the state records. Because of differences of classification in deaths, it has been necessary to base the rates on the deaths recorded as "tuberculosis of the lungs" to get comparable data for these years. The rate calculated from the state records for "tuberculosis of the lungs" has been multiplied by a factor based on the proportion such deaths bore to those from tuberculosis, all forms. This factor varied with the year and age considered.

This is demonstrated in Figures 3 and 3a, which show for males and females in Massachusetts the death rates at specific ages in the

years 1880 and 1930, and also those for each age of the cohort of 1880 or that group of people who were born in the years 1871 to 1880. These graphs indicate that the group of people who were children 0 to 9 years of age in 1880 and who are now aged 50 to 60 years (if alive) have, in two earlier periods, passed through *greater* risks. They also indicate that the age selection in the cohort of 1880 is quite different from that *apparently* indicated by the age specific mortality rates for any single year.

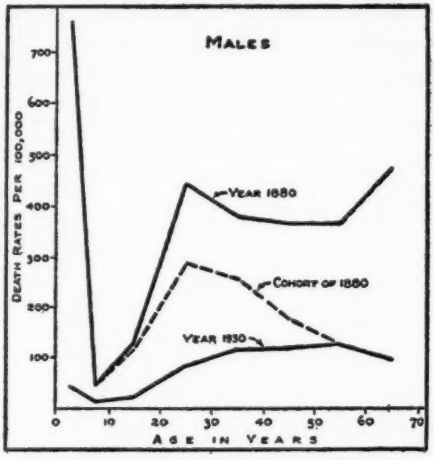

Fig. 3. Massachusetts death rates from tuberculosis—all forms—by age, in the years 1880 and 1930 and for the cohort of 1880.

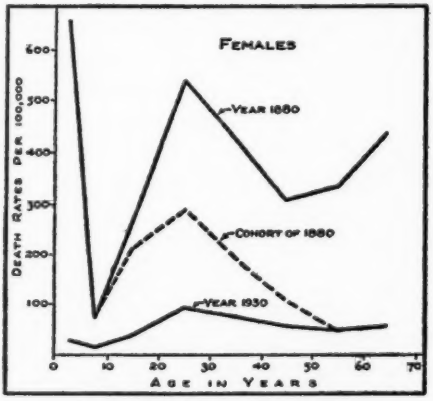

Fig. 3a. Massachusetts death rates from tuberculosis—all forms—by age, in the years 1880 and 1930 and for the cohort of 1880.

Figure 4 shows similarly for males the mortality at successive ages in cohorts of (1870), 1880, 1890, 1900, 1910. Note that "terminal" rates for these cohorts make the 1930 curve, and also that in successive cohorts the age selection has been uniform; with the mortality highest in the first 5 years and again from 20 to 30 years; thereafter it declines.

This fact was previously noted by K. F. Andvord (1930). His interpretation was, in part, that this regularity of the age curve formed a basis for extending estimates of future mortality in the same cohort at higher ages. Such an interpretation is both tempting and encouraging but perhaps dangerous.

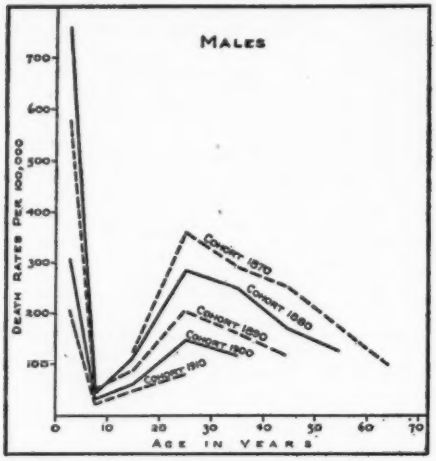

Fig. 4. Massachusetts death rates from tuberculosis—all forms—by age, in successive ten-year cohorts.

Without attempting to interpret the facts in detail, certain implications are noted.

1. Constancy of age selection (*relative* mortality at successive ages) in successive cohorts suggests rather constant physiological changes in resistance (with age) as the controlling factor.

2. If, as we may suppose, the frequency and extent of exposure to infection in early life have decreased progressively decade by decade, there is no indication that this has had the effect of exaggerating the risk of death in adult life due to lack of opportunity to acquire specific immunity in childhood.

3. Present day "peak" of mortality in *late* life does not represent postponement of maximum risk to a later period, but rather would seem to indicate that the present high rates in old age are the residuals of higher rates in earlier life.

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United States Mortality Statistics.

DENTAL CARIES IN BROTHERS AND SISTERS OF IMMUNE AND SUSCEPTIBLE CHILDREN[1]

HENRY KLEIN AND CARROLL E. PALMER

INTRODUCTION

SIMILARITIES within families with respect to relative immunity or susceptibility to dental caries have been noted by several investigators. In a study of 325 children and their parents, Day and Sedwick (1) report that the parents of children with extensive caries showed an average loss of two permanent teeth more than the parents of children with low levels of caries. Bunting (2) states that "inherited or inherent individual characteristics, in a small percentage of cases, are more important determinant factors in caries susceptibility than ordinary dietary considerations." Kappes (3) has reported that among the parents of fifty children with "good teeth" two parents had "poor teeth" and nine had "good teeth," while among the parents of fifty children with "poor teeth" thirteen had "poor teeth" and two had "good teeth." Detlefsen (4) has observed that the extent of caries in the first permanent molars appears to have a small but appreciable genetic background. In a discussion of the problem of clinical control of dental caries, Kugelmass (5) points out that "hereditary predisposition to caries susceptibility or immunity appears evident in some children." Further data on familial resemblances in caries in the brothers and sisters of immune and susceptible children are given in a recent paper by Miller and Crombie (6).

Detailed analyses of the constitution of the caries problem in large population groups would appear to warrant further study of the relation between familial factors and relative susceptibility to caries. Accordingly, an investigation of this relationship was de-

[1] From the Division of Public Health Methods, National Institute of Health, Bethesda, Maryland. The present paper was published in a slightly different form in *Public Health Reports*, August 5, 1938, 53, p. 1353.

veloped as one of a series of studies on dental caries in grade school children (7), (8), (9), (10), (11), (12), (13), (14), (15). The present paper is concerned largely with a description of the dental status of the brothers and sisters of one group of children designated as "caries immunes" and those of another group designated as "caries susceptibles." Analysis of the data furnishes quantitative evidence which indicates that significantly less caries is found in the deciduous and in the permanent teeth of the brothers and sisters of the immune group than in those of the caries susceptible group.

MATERIAL AND METHODS

Basic data[a] for the present study were obtained from dental examinations of 4,416 elementary school children who comprised 94 per cent of the entire enrolled grade school population of a small urban community, Hagerstown, Maryland. Records of these examinations contained observations on the number of deciduous and permanent teeth present in the mouth and detailed descriptions of the location and specific surface involvement of the teeth by caries. Carious lesions were those so designated by trained dental officers on the basis of a careful clinical examination with mirror and sharp pointed pig-tail explorer. Pits and fissures in which the explorer caught were itemized separately. For the permanent teeth, caries experience was measured by means of a count of decayed, missing, or filled (DMF)[b] teeth and tooth surfaces. In counting carious tooth surfaces, remaining roots and missing (extracted) permanent teeth were considered equal to five carious surfaces. For the deciduous teeth, an equivalent measure of the total caries experience was not possible, since definite information which would show whether or not a missing deciduous tooth had ever been carious was not available from the data collected. For the deciduous teeth, therefore, caries experience was expressed by means of a count of teeth and

[a] A full description of the manner of collecting these data and a general analysis of the findings are given in reference 7.

[b] For a full discussion of the DMF concept, see reference 16.

tooth surfaces which, at the time of the examination, were actually carious or were filled.

Definitions and the Selection of Immune and Susceptible Children. For purposes of the present analysis, certain children from among the 4,416 examined were selected as "caries immunes" and "caries susceptibles." Immune children were defined as those who at ages ten through fifteen showed *in the permanent teeth* no objective evidence of caries experience (no DMF teeth). Caries susceptible children were defined as those who at age ten had six or more; at age eleven, seven or more; at age twelve, eight or more; at age thirteen, nine or more; and at ages fourteen and fifteen, ten or more DMF teeth.

These criteria are clearly arbitrary, and it is recognized that entirely homogeneous groups were not selected thereby. An important disturbing factor probably arises from the fact that different levels of relative immunity to caries are represented in the immune group. For example, a child fifteen years of age who has no carious permanent teeth may possess a higher level of immunity than a child of ten who, though not having DMF teeth at this age, may develop the disease by the age of fifteen. Similar disturbing factors may be present in the definition of susceptibles, although it seems probable that these are partially obviated by the graduated scale of defining susceptibility in terms of the severity of the disease.

In connection with a discussion of the comparability of the immune and susceptible children, it is necessary at this point to mention the unexpected finding of significant differences in the populations of teeth in the two groups of children. In brief, this consisted of the finding of a greater average number of erupted permanent teeth in the susceptibles than in the immunes and, as a direct corollary, a smaller average number of deciduous teeth present in the mouths of the susceptibles than in the mouths of the immunes. The full significance of this observation is not immediately apparent and requires additional study. In explanation, how-

ever, it may be mentioned that the method of designating the immunes and the susceptibles probably accounts, in part, for the differences, since children selected as susceptibles were required to have a specified minimum number of DMF teeth, and those selected as immunes no DMF teeth.

By these criteria, children with larger numbers of erupted permanent teeth may tend to fall into the susceptible group; those with smaller numbers of erupted teeth may tend to fall into the immune group. A specific mechanism which might bring about this differential selection may be illustrated as follows: If the teeth of a particular child tend to erupt at an early age, these teeth will have been exposed to the environment of the mouth longer, at the same chronological age, than will be those of a child whose teeth tend to erupt at a relatively late age. Since attack by dental caries is related to the length of time the teeth are exposed in the mouth, children whose teeth erupt early may be expected to show, at the same chronological age, more caries than children whose teeth erupt late. The selection of susceptible children (those having a specified minimum number of DMF permanent teeth) may tend to pick out individuals who are "early eruptors";[4] immune children, on the other hand, may tend to be "late eruptors." The presence of relatively more early eruptors in the susceptible group and relatively more late eruptors in the immune group may be the factor which accounts for the finding of more erupted permanent teeth in the former than in the latter group of children. As just indicated, however, the full significance of this finding is not clear at the present time. Nevertheless, its possible implications must be borne in mind in studies on the relative immunity and susceptibility of children to dental caries.[5]

[4] "Early eruptors" may be expected to have, at comparable ages, more permanent teeth erupted than "late eruptors."

[5] In order to compare the caries experience of two groups of children of the same chronological age, one group having significantly more permanent teeth erupted than the other, it would appear to be necessary to take account of the fact that the teeth of one group have

(Continued on page 71)

Of the grade school pupils examined, 357 children were designated as caries immune and 270 as caries susceptible by means of the criteria previously described. Since nearly all of the children of elementary school age in the community were examined, dental records for essentially all of the brothers and sisters (of school age) of these immune and susceptible children were available for study. Some of the caries immunes and caries susceptibles themselves fell within the brother-sister group. Two such immunes were observed in each of twenty-seven families, and two such susceptibles were observed in each of thirteen families; three immunes were found in each of two families and three susceptibles in three families; four immunes were observed in one family. In two families, one immune and one susceptible were found per family.

Selection of Brothers and Sisters of Immune and Susceptible Children. In the material under analysis, the families fall into two major groups: (a) those in which only one immune or susceptible child was observed, and (b) those in which there were observed more than one immune or more than one susceptible child. In the first group of families, all children examined, except the immune or susceptible child, were placed in the brother-sister group. In the second group, the older or eldest immune or susceptible child was selected as the index case, and the other children, regardless of their relative immunity or susceptibility, were grouped within the brother-sister class. For the two families in which both an immune and a susceptible were found, the immune child was counted among the brothers and sisters of the susceptibles in one family, and the susceptible child was counted among the brothers and sisters of the immunes in the other family.

Index Cases and the Brother-Sister Class. By means of the procedures and criteria discussed in the preceding sections, two special

been exposed to the environment of the mouth for a longer period of time than the teeth of the other group. One method of taking account of this factor involves the expression of caries experience in terms of "posteruptive tooth age." An application of this method will be found in a later section of this paper.

classes of children were obtained: First, a group of 184 immune and a group of 117 susceptible *propositi or index cases;* second, a special class composed of a group of 306 brothers and sisters of immune index cases and a group of 182 brothers and sisters of susceptible index cases. Among the 306 brothers and sisters of immunes, there were included, by the method used for designating the brother-sister class, thirty-four children who meet the criteria for immunes and one who meets the criteria for the susceptibles. Among the 182 brothers and sisters of susceptibles, nineteen children meet the criteria of susceptibles and one child meets the criteria of immunes.

Since each index case represents a family containing one or more immune or susceptible children, it may be noted that 184 "caries immune families" and 117 "caries susceptible families" constitute the number of different family groups from which the children are drawn. The age and sex distributions of the 301 index cases through which these families were selected, as well as the distributions for their 488 brothers and sisters are given in Table 1.

FINDINGS

Caries Immunes and Caries Susceptibles Within the Same Family. Preliminary to the presentation of findings on the dental status of the brothers and sisters of the immune and susceptible index cases, information of some significance regarding one aspect of the familial characteristic of caries can be derived from a study of the distribution of caries immunes and caries susceptibles within families. Thus, the fact may be derived from the material presented previously that two or more immunes were found in thirty families, two or more susceptibles in sixteen families, and in only two families were both an immune and a susceptible observed. No detailed test will be presented here of the statistical significance of this distribution of occurrence of more than one immune, or susceptible, child in the same family; but it is apparent that certain families are marked by caries immunity while other families are characterized

Sex	Caries Group	Age (Years Last Birthday)										
		6	7	8	9	10	11	12	13	14	15	All Ages
		INDEX CASES										
Boys	S	—	—	—	—	3	8	13	8	8	7	47
	I	—	—	—	—	26	22	16	26	7	1	98
Girls	S	—	—	—	—	14	7	14	17	12	6	70
	I	—	—	—	—	30	26	19	6	3	2	86
Both Sexes	S	—	—	—	—	17	15	27	25	20	13	117
	I	—	—	—	—	56	48	35	32	10	3	184
		BROTHERS AND SISTERS										
Boys	S	3	11	15	10	17	15	14	8	2	2	97
	I	16	17	25	19	21	16	20	15	11	1	161
Girls	S	8	5	8	14	15	6	9	13	4	3	85
	I	7	13	28	24	17	8	18	14	15	1	145
Both Sexes	S	11	16	23	24	32	21	23	21	6	5	182
	I	23	30	53	43	38	24	38	29	26	2	306

Table 1. Age and sex distributions of 301 caries immune (I) and caries susceptible (S) index cases and those of their 488 brothers and sisters. (Data derived from dental examinations of 4,416 grade school children, Hagerstown, Md.)

by caries susceptibility. Such an impression may be derived from the simple fact that forty-six out of forty-eight families each contain two or more children who show similarity in respect to caries immunity or susceptibility while in only two families does this direct similarity fail to hold. This preliminary finding strongly suggests the existence of familial resemblances in caries immunity and susceptibility.

Methodological Considerations in the Comparison of Caries Experience in the Permanent Teeth of the Brother-Sister Classes. On the basis of the data just presented, brothers and sisters of immune children might be expected to show significantly lower levels of caries experience than those of caries susceptible children. Before proceeding with the presentation of detailed data in this connec-

tion, however, it becomes necessary to discuss the fact that the brothers and sisters of the susceptible index cases have a larger average number of erupted permanent teeth, and a smaller average number of deciduous teeth than the brothers and sisters of immune children. This difference between the two groups parallels the previously mentioned difference between the susceptible and immune children themselves. Data revealing this finding are shown in Table 2, which gives tabulations of the average numbers of permanent and deciduous teeth in the brother-sister classes and their index cases. The differences between the two groups of index

Table 2. Average numbers of erupted permanent teeth and of deciduous teeth present in the mouths of (a) 306 immune (I) and susceptible (S) index cases, and (b) of their 488 brothers and sisters. (Data derived from dental examinations of 4,416 grade school children, Hagerstown, Md.)

Item Tabulated	Sex and Caries Designation	Age (Years Last Birthday)									
		6	7	8	9	10	11	12	13	14	15
		(a) index cases									
Average Number Erupted Permanent Teeth per Child	Boys (S)	—	—	—	—	*	22.4	26.2	26.9	27.5	27.4
	(I)	—	—	—	—	15.4	19.3	20.7	26.6	26.1	*
	Girls (S)	—	—	—	—	19.5	24.4	25.6	27.2	27.2	27.5
	(I)	—	—	—	—	16.6	21.4	24.2	26.7	*	*
Average Number of Deciduous Teeth Present per Child	Boys (S)	—	—	—	—	*	1.9	.1	.3	.1	.3
	(I)	—	—	—	—	7.7	4.3	3.4	.3	.3	*
	Girls (S)	—	—	—	—	3.4	.3	.5	0	.1	0
	(I)	—	—	—	—	6.0	3.1	1.4	.2	*	*
		(b) brothers and sisters									
Average Number Erupted Permanent Teeth per Child	Boys (S)	*	7.3	10.7	13.7	15.6	21.1	22.8	26.3	*	*
	(I)	4.7	6.7	10.2	12.3	14.4	19.2	23.3	25.2	27.6	*
	Girls (S)	6.6	10.6	11.8	16.5	18.0	21.8	25.9	26.5	*	*
	(I)	4.9	8.7	11.3	13.1	16.5	22.6	23.8	25.1	27.5	*
Average Number of Deciduous Teeth Present per Child	Boys (S)	*	15.5	11.3	8.4	6.7	2.6	1.3	.1	*	*
	(I)	17.4	14.8	12.4	9.7	7.9	3.9	1.6	1.2	.1	*
	Girls (S)	16.0	10.0	11.1	4.3	3.9	1.8	.6	.2	*	*
	(I)	15.6	13.0	11.3	9.5	6.2	2.3	1.7	1.1	0	*

* Values based on less than five cases are omitted.

cases are readily apparent. For the brother-sister groups, if comparisons between the separate age-sex groups are restricted to those in which the averages are based on more than five children, it becomes evident that brothers and sisters of immunes definitely have fewer permanent teeth at comparable ages than do brothers and sisters of the susceptibles.

Further analysis of these data, although not reproduced here, leads to the significant conclusion that the brothers and sisters of immunes have, during the period of eruption of the permanent dentition, an average of approximately one erupted permanent tooth less than is found in the brothers and sisters of the susceptibles of comparable chronological age. The finding of lesser numbers of deciduous teeth in the brothers and sisters of susceptibles and greater numbers in those of immunes may be explained in part by these differences in eruption of the permanent teeth.*

In the light of these findings, the question may well be raised as to what analytical procedures are required for making a precise comparison of the caries experience of the two brother-sister groups. Since larger numbers of permanent teeth are present in the brothers and sisters of susceptibles, more teeth would be available for attack by caries and, because of this fact, more teeth might be found carious. Moreover, a larger number of erupted permanent teeth implies earlier eruption and, therefore, a longer period of mouth exposure during which attack by caries might take place.

This discussion leads directly to an attempt to express the caries experience in terms of the length of time the teeth are exposed to the risk of attack by caries. In a recent paper (9), a method for estimating the time of exposure of teeth in the mouth, *accumulated posteruptive tooth age,* is described. The following simple example will serve, for present purposes, to define the term *"accumulated posteruptive tooth age":* A child of exactly seven years of age has

* The finding of these differences in numbers of permanent and deciduous teeth in the sibling groups, which parallel similar differences between the two groups of index cases, strongly suggests the existence of familial resemblances in eruption patterns.

five permanent teeth erupted. The two lower first molars erupted at six years of age, the two upper first molars at six and one-half years, and the lower right central incisor erupted at six years, nine months of age. The accumulated posteruptive tooth age for this child is, therefore, three and one-fourth years; two years for the lower molars, one year for the upper molars, and one-fourth year for the incisor. This determination of length of time the teeth are exposed in the mouth is the sum of actually observed durations of exposure of the separate teeth. Where direct observations of this character are not available, it is possible to estimate the average value of accumulated posteruptive tooth age from quantitative data on the eruption of the teeth. Details of the mathematical derivation of these values are given in reference (9), in which is included a

Table 3. Number of decayed, missing, or filled (DMF) permanent teeth and tooth surfaces per child, and accumulated posteruptive tooth age per child, of brothers and sisters of immunes (I) and brothers and sisters of susceptibles (S). (Data derived from dental examinations of 4,416 grade school children, Hagerstown, Md.)

Item Tabulated	Sex and Caries Designation	Age (Years Last Birthday)									
		6	7	8	9	10	11	12	13	14	15
Number of DMF Permanent Teeth per Child	Boys (S)	*	1.0	1.9	3.0	3.0	3.9	6.0	5.0	*	*
	(I)	0	.6	.6	1.0	1.4	1.6	2.7	3.0	2.6	*
	Girls (S)	.9	1.6	1.0	2.9	3.1	4.2	4.3	8.2	*	*
	(I)	.3	.4	.9	1.0	1.5	1.6	2.3	2.9	4.5	*
Number of DMF Permanent Tooth Surfaces per Child	Boys (S)	*	2.1	2.5	5.5	6.7	7.0	13.3	13.6	*	*
	(I)	0	.7	.8	1.4	2.9	3.4	4.5	7.6	4.0	*
	Girls (S)	1.6	1.6	1.3	7.4	5.7	8.0	8.8	15.6	*	*
	(I)	.6	.4	1.2	1.8	2.7	1.9	4.7	5.5	9.7	*
Accumulated Posteruptive Tooth Age in Years per Child[1]	Boys (S)	*	6.5	15.7	30.0	39.5	66.7	77.0	107.0	*	*
	(I)	3.3	5.5	14.0	23.0	33.5	57.0	80.0	94.0	—	*
	Girls (S)	6.0	15.0	19.5	40.7	47.5	67.0	104.0	113.5	*	*
	(I)	3.7	9.5	17.3	25.5	40.5	72.5	82.0	95.5	—	*

* Values based on less than five cases are omitted.

[1] The values of accumulated posteruptive tooth age given here were derived from a nomogram (Fig. 3 in reference 9) relating average number of erupted permanent teeth to tooth age. The average numbers of erupted permanent teeth for the different age-sex groups of brothers and sisters are given in Table 2 of this paper. Since the relationship between the number of erupted teeth and posteruptive tooth age cannot be considered as accurately determined when the number of erupted teeth approaches twenty-eight, the table does not give tooth age values for average numbers of erupted teeth above twenty-seven.

nomogram from which it is possible to obtain estimated average values of posteruptive tooth ages for given average numbers of erupted permanent teeth.

Caries Experience in the Permanent Teeth of the Brother-Sister Classes. Table 3 gives data from which it is considered possible to make an accurate and precise comparison of dental caries experience in the permanent teeth of brothers and sisters of the immune and those of the susceptible index cases. The first section of the table shows the number of decayed, missing, and filled (DMF) permanent teeth per child; the second section shows the number of DMF tooth surfaces per child, and the third section gives the average accumulated posteruptive tooth age per child for each age-sex group of the brother-sister classes. Inspection of the upper two divisions of the table indicates that the brothers and sisters of the susceptibles generally have of the order of twice as many teeth and tooth surfaces attacked by caries as the brothers and sisters of the immunes.

Although several different methods may be adopted for showing, in the two groups, the relation of posteruptive tooth age to attack by caries, the purposes of the present discussion are perhaps best served by the graphic presentation of data as given in Figure 1. Despite some irregular variation of the individual curves, the heavy solid lines, representing moving averages,[7] for the combined sexes, show very clearly a striking difference between the two groups. When posteruptive tooth age reaches an average of ten years per child, the brothers and sisters of the immunes have slightly less than one carious surface per child, while the brothers and sisters of the susceptibles have nearly two carious surfaces per child; when tooth age reaches fifty years, the brothers and sisters of immunes show less than three DMF surfaces, while those of the susceptibles show more than seven DMF surfaces. Ratios, for the two groups, of

[7] Each point of the moving average represents the mean of six values, three for boys and three for girls. These six values were obtained by reading the ordinates from the irregular line curves for successive ten-year units of accumulated posteruptive tooth age.

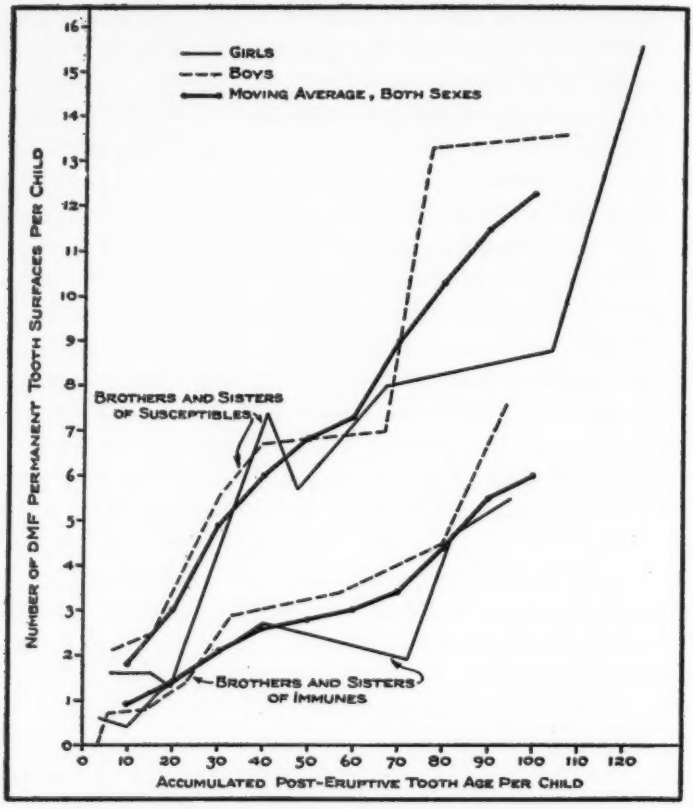

Fig. 1. The relation between accumulated posteruptive tooth age and the number of decayed, missing, or filled (DMF) permanent tooth surfaces.

the number of tooth surfaces attacked by caries for different comparable levels of tooth age indicate that from two and one-fourth to two and one-half times as much caries is present in the permanent teeth of the brothers and sisters of the susceptibles as is found in brothers and sisters of the immunes.

Caries in the Deciduous Teeth of the Brother-Sister Classes. For reasons fully discussed in a previous publication (7) and mentioned

Item Tabulated	Sex and Caries Designation	Age (Years Last Birthday)									
		6	7	8	9	10	11	12	13	14	15
Number of Deciduous Teeth Present	Boys (S)	*	170	170	84	114	39	18	1	*	*
	(I)	278	251	311	185	166	62	32	18	1	*
	Girls (S)	128	50	89	60	58	11	5	3	*	*
	(I)	109	169	317	229	105	18	31	16	0	*
Number of Carious[1] Teeth per 100 Teeth Present	Boys (S)	*	43.5	61.2	57.1	51.8	64.1	55.6	100.0	—	—
	(I)	11.2	29.1	36.0	37.8	34.3	41.9	43.8	33.3	100.0	—
	Girls (S)	55.5	76.0	48.3	63.3	55.2	90.9	60.0	100.0	—	—
	(I)	30.3	18.9	34.7	32.8	35.2	16.7	48.4	37.5	—	—
Number of Carious[1] Tooth Surfaces per 100 Teeth Present	Boys (S)	*	89.4	154.1	122.6	128.1	182.1	144.4	500.0	—	—
	(I)	20.1	57.8	69.5	91.4	66.9	72.6	84.4	61.1	200.0	—
	Girls (S)	126.6	238.0	100.0	133.3	124.1	154.6	100.0	200.0	—	—
	(I)	45.0	36.7	70.7	65.9	69.5	22.2	119.4	100.0	—	—

* Values based on less than five cases are omitted.
[1] Decayed or filled.

Table 4. Data showing caries present in the deciduous teeth of 488 brothers and sisters of immune (I) and susceptible (S) index cases. (Data derived from dental examinations of 4,416 grade school children, Hagerstown, Md.)

earlier in this paper, caries experience cannot be completely reconstructed for the deciduous teeth from survey data such as are available for the present study. An *approximation* of the level of caries in deciduous teeth may be obtained, however, by expressing the number of teeth or tooth surfaces observed to be carious, and (or) filled, as a ratio (times 100) of the total number of deciduous teeth present in the mouth.[8] Data arranged in this form are given in Table 4 for the two brother-sister groups, and Figure 2 illustrates graphically the relation between chronological age and the number of carious deciduous tooth surfaces per 100 deciduous teeth present in the mouth. In general, this material shows that caries in the deciduous teeth of brothers and sisters of susceptibles is approximately twice as extensive as in the brothers and sisters of immunes.

Obviously this finding, and its interpretation, is not entirely con-

[8] Such an arrangement of the data tends also to equalize differences, such as are present in the two groups under investigation here, in the number of deciduous teeth present in the mouth.

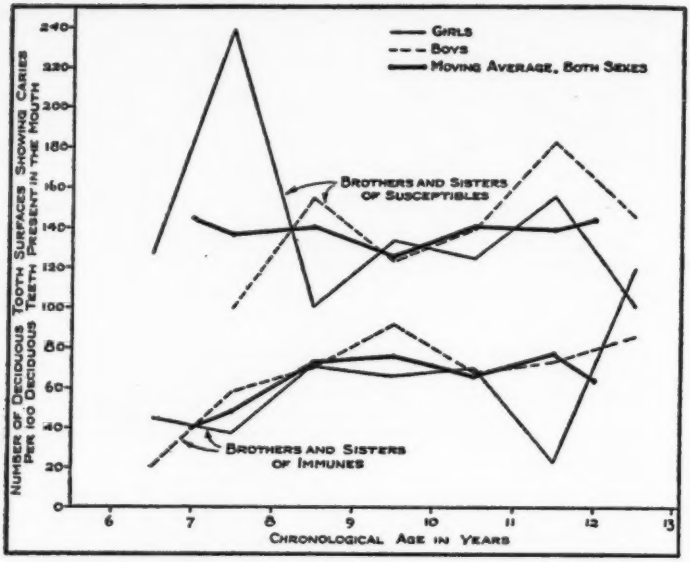

Fig. 2. The relation between chronological age and number of carious or filled deciduous tooth surfaces per 100 deciduous teeth present in the mouth. (The heavy solid lines represent three-point moving averages, except that the points at the two ends of the age range represent two-point averages.)

clusive, since the two brother-sister groups are markedly different in numbers of deciduous teeth present in the mouth, and, very probably, the length of time the deciduous teeth have been present in the mouth may be different for the two contrasted groups of children. From one point of view, it is possible that the finding in the brothers and sisters of susceptibles of approximately double the amount of caries found in those of the immunes may constitute an *understatement* of the actual differences between the two groups. Thus it may be recognized that the finding of fewer deciduous teeth present in the mouths of the brothers and sisters of the susceptibles may represent, in part, the premature loss of these teeth because of severe caries. On the whole, therefore, it seems reasonable to conclude that the analysis of the data indicates a definite

difference between the two groups in attack of the deciduous teeth by caries, and that this difference is of the order of two to one, in brothers and sisters of susceptibles as compared with brothers and sisters of immunes.

SUMMARY AND CONCLUSIONS

This paper contains the preliminary results of a study on familial characteristics of dental caries. The basic data were derived from records of dental examinations of essentially all of the elementary school children in an urban community (Hagerstown, Md.), which has a population of approximately 30,000 persons. The major steps in the analysis are as follows: from the dental records of 4,416 white children, two defined groups were selected—one, those being relatively immune to caries, the other, those showing relatively high susceptibility to caries. Records for the brothers and sisters, of grade school age, of the "immunes" and "susceptibles" were then assembled and analyzed to show the level of caries in the two contrasted groups of brothers and sisters. The results of the analysis indicate that brothers and sisters of susceptibles have somewhat over twice as much caries in both the permanent and deciduous teeth as do brothers and sisters of the immunes. Since the material available for study constitutes a relatively large sample of children, it is possible to conclude that the existence of familial resemblances in caries experience of children is definitely established. In this paper, and at the present time, no specific explanation is offered for the observed familial differences.

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ANNOTATIONS

POPULATION: TODAY'S QUESTION[1]

THIS is an excellent little book, in my opinion the best introduction to the study of population trends and their implications since Wright's POPULATION, which it will largely replace, being more recent. The objective of the author has been pleasantly achieved, as set forth in the following excerpt from the preface:

> People who are interested in the population question seem to fall into three groups. Some view the decline in the birth-rate with disquiet, fearing that it will lead to disaster; others welcome it as tending to reduce unemployment and to alleviate what are thought to be other symptoms of overpopulation. The third group, which is probably the largest, is made up of people who wish to know more of the question before forming a definite opinion one way or the other. It is mainly for the assistance of the third group that this book is intended. Its aim is to give an impartial account of the more important aspects of the population question as they appear at the present time.

But there are many things in this book that are new, at least to the reviewer, mainly of historical character. In the first chapter entitled, "Before Malthus," the scholarship of the author is indicated by excerpts from Goldsmith, J. S. Mill, Cotter Morison, *Genesis, Psalms,* Zola, Grote, Holm, Aristotle, Polybius, Bacon, Cunningham, Roscher, Schmoller, Queen Elizabeth, Colbert, Quesnay, B. Franklin, Alcock, Arthur Young, Joseph Townsend, Hansard, and Whitbread, all woven into a delightful story requiring only twenty-five very small pages.

The next chapter on Malthus is equally well done—filled with sympathetic interpretation, admirable summary, and brilliant comment, par-

[1] McCleary, G. F.: POPULATION: TODAY'S QUESTION. London, George Allen and Unwin, Ltd., 1938, 222 pp. $2.10.

ticularly those on the law of diminishing returns and the optimum population.

Chapter III, "The Great Population Increase," begins with a pertinent quotation from Boswell's LIFE OF JOHNSON, and then summarizes and comments upon the statistical data relating to the last two centuries, a unique period in which the population of the world has increased probably twice as much as in all the centuries preceding.

Then comes a chapter entitled, "The Balance of Births and Deaths," appropriately introduced by a quotation from Kuczynski. Other chapters are entitled, "Reproduction in Europe"; "Birth Control"—an excellent chapter, largely historical, which shows that contraception has been practiced since the days of ancient Egypt; "The Desire for Family Limitation"; "Some Social and Economic Consequences of a Declining Population"—a pleasant, noncontroversial discussion, which clearly shows, however, the profound implications in present trends; "The Pursuit of Population"; and "Quality and Quantity."

Only in the last chapter, "Conclusion," does the author reveal his personal opinions. Three quotations are pertinent:

> Nothing that we can do in the reduction of mortality can prevent the decline. It can only be prevented by an increase in fertility. It cannot too strongly be emphasized that we are not moving towards a stationary population. If that were so, it could reasonably be contended that there is no cause for disquiet. We are moving towards a rapid diminution in the number of our people, and it is a movement towards disaster. . . .
>
> What are we to do about it? Two things at all events should be done. One is to make the facts of the position widely known. Nothing is more deeply rooted in the public mind than that our unemployment figures prove that there are too many people in the country, and that it is a sign of a good citizen that he should have few children or no children at all. Such ideas are held even in quarters where a more instructed view might well be expected. There is general agreement among those who have given special attention to population problems that the fall in the birth-rate has been brought about mainly, if not entirely, by the voluntary limitation of the family. It is a question of the will, and the will is powerfully influenced by the prevailing ideas of the time. One of those ideas is the fear of over-population; and until it is dispelled it is vain to expect that fertility will rise sufficiently to prevent the rapid population decline that looms ahead.

> The second thing we have to do is to make a thorough study of the population question as a preliminary step towards formulating a population policy. We do not know enough to say what measures are likely to be effective in raising fertility. The experience of other countries does not encourage us to follow their example. In no country, except Germany, is there anything definite to show for the efforts that have been made; and the conditions in which the birth-rate has risen in Germany, since the coming into power of the National Socialists in 1933, are so exceptional that it would be unsafe to assume that what has been effective there would be effective elsewhere. It would be useless to embark upon a population policy until we have good grounds for thinking that it would take us where we want to go. . . .
>
> Experience shows that it is much easier to get the birth-rate down than to get it up. We shall probably find, adapting Mill's words quoted at the head of this chapter, that when the object is to raise the fertility of a people, "small means do not merely produce small effects; they produce no effects at all."

This is a popular, yet a profound book, done in the simple readable style of the English scholar.

O. E. Baker[2]

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THE VITAMINS

Just six years ago a symposium on the vitamins which had appeared in *The Journal of the American Medical Association* was published in monograph form. Now a second symposium on that subject[1], after having appeared last year in the same *Journal,* is likewise published as a monograph.

The opening sentence strikes the keynote when it states: "The achievements in the science of nutrition which have developed in recent years are among the most significant of all that have been made in modern medical science." And the succeeding chapters bear out this assertion.

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[1] THE VITAMINS. A Symposium Arranged under the Auspices of the Council on Pharmacy and Chemistry and the Council on Foods of the American Medical Association. Chicago, American Medical Association, 1939, 637 pp. $1.50.

Nothing so graphically reflects the phenomenal growth in knowledge in this fundamental field as the three-fold increase in length in this new publication. Especially has the isolation and synthesis of the vitamins given fresh impetus to this already rapidly advancing subject. Hence topics slightly mentioned in a sentence or paragraph in the first book because of sparsity of data now occupy their own chapters. The first monograph had ten chapters; this one requires thirty-one. Discussed for each of the vitamins are their chemistry, their sources in foods, bodily requirements for them, their physiology, the pathology of avitaminoses, and pharmacological and therapeutic facts and properties. Also included are two chapters on ultra-violet radiation. Amazing as is the rapid development, in the vitamin sector of the nutritional field, the end is not yet. Of this a hint is given as the book closes with a chapter on other factors—less well-known vitamins. In arrangement and scope the book was indeed well conceived and well planned.

This enlarged task brought the number of authors to thirty, each top-flight in his topic. These experts have turned out a valuable, authoritative book. As a collaborative work it possesses certain features characteristic of such joint authorship. There is diversity of view which dispels dogmatism in interpretation and imparts to it vigor. Even some slight repetition accents facts which bear repetition. Out of a wealth, if not a welter of facts, the authors have shown fine discrimination in selection of material. The book is packed with much detailed worthwhile information, yet concisely written; it is scholarly yet practical. So high is the level of all the chapters that it would be unfair to single out any one for special mention. But, as an instance of workmanship which readers will not be slow to appreciate, such a difficult and debatable topic as the exact human requirements of the several vitamins, expressed in quantitative terms, has been treated forthrightly, critically, and thoroughly.

Nutrition cuts across all branches of medicine. Physicians who formerly regarded diet and nutrition as something unrelated and remote to their particular specialties have come to realize that they are neck-deep in nutritional problems. This monograph pertains to one important group of dietary essentials, the vitamins, so vital to nutrition. Here is a book for all: the nurse, the nutritionist, the graduate student in biological sciences, the student of medicine, the practitioner, the public health officer. In it each will find much useful information.

H. D. Kruse, M.D.